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ANNUAL AIR QUALITY DATA SUMMARY FOR MONTANA

1977

By

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Helena, Montana

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I. INTRODUCTION

This report is the third annual air quality data summary published by the Montana Department of Health and Environmental Sciences (DHES). The data presented consists of that data gathered in air quality monitoring in the five Air Quality Control Regions for 1977. This report is divided into two main sections. Section II and the main body of the report is orientated toward the general public who wishes an overall report on the air quality of Montana for 1977. The pollutants addressed in this section are sulfur dioxide and total suspended particulates. Section III is orientated toward individual special studies performed throughout the state. This section summarizes all air pollutants measured in each study area.

Appendix A summarizes the federal and Montana ambient air quality standards. Appendix A also contains a description of the Prevention of Significant Deterioration (PSD) increments and area classifications.

Appendix B lists the staff involved in the air quality studies.

The data collected in this report consists of that data gathered by monitoring activities of the Air Quality Bureau of the Montana Department of Health and Environmental Sciences: the Cascade County Air Pollution Control; the Missoula City-County Health Department; and the Yellowstone County Air Pollution Control

The map in Figure 1 illustrates the five Air Quality Control Regions (AQCR) for Montana. The data in Section II of this report discusses the results of monitoring by AQCR.

Figure 1

Montana Air Quality Control Regions

II. GENERAL AIR QUALITY

II. GENERAL AIR QUALITY

A. Billings Air Quality Control Region - Region 140

The annual arithmetic mean for total suspended particulates for all stations in Region 140 during 1977 was 46.3 micrograms/cubic meter. The region contains 11 counties and many of the counties are very sparsely populated. Therefore, the levels of particulates vary largely, with the Billings metropolitan area having the highest averages. The Region 140 has a population of 135,243 with 56 percent of these located in the Billings-Laurel metropolitan area. The maximum annual geometric average* recorded in the Billings area was 47.7 micrograms/cubic meter and the highest 24-hour level measured was 166 micrograms/cubic meter. Sulfur dioxide for the region was measured only in the Billings metropolitan area. Measurements showed arithmetic average concentration of approximately 0.03 parts per million. Table 2 summarizes sulfur dioxide and particulate data for selected sites in the region. Both the federal and Montana ambient air quality standards for sulfur dioxide were exceeded during 1977 and the federal secondary standard for particulates was exceeded. Figure 2 shows graphically the trend of the particulate levels in the Billings area. The trend indicates little change in the average concentrations but the maximum 24-hour reading for each year appears to be increasing.

Primary industries in this region are cattle ranching, farming, oil and gas production, coal mining, and petroleum refining and transportation. Two sawmills are located in this region. Table 1 indicates the estimated emissions from the major sources in the region. Other than the power plant in Billings, the largest point sources are the three refineries which emit large quantities of particulates, sulfur dioxide, nitrogen dioxide, and hydrocarbons.

---

*Geometric average given here to compare with ambient air quality standards. (Appendix A)

Table 1 also shows the estimated emissions from the major area sources in the region. In AQCR 140 the largest area source of particulates is unpaved roads with agriculture ranking as the second highest emitter.

FIGURE 2

Trend of Total Suspended Particulate Concentrations Measured in the Billings Area

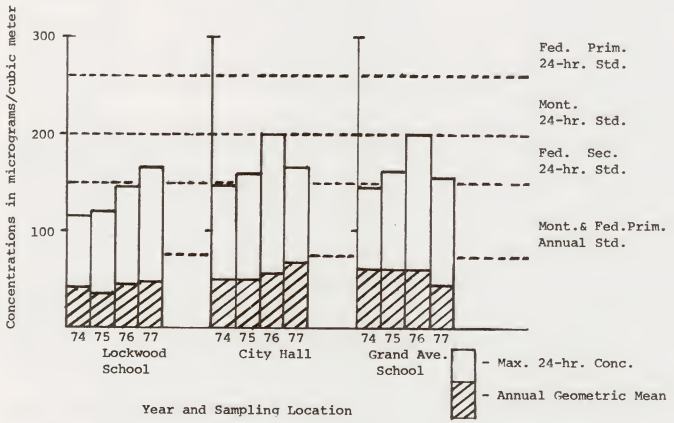


TABLE 1

Billings Air Quality Control Region - Region 140
Major Sources Estimated Emissions - 1977

Sources	Estimated Emissions (Tons Per Year) Sulfur Dioxide	Particulates
Point Sources		
Cenex Laurel	11,830	398
Conoco Billings	3,198	263
Exxon Billings	9,800	932
Great Western Sugar Co. Billings	815	65
Montana Power Company Billings	9,986	1,197
Montana Sulphur & Chemical Co. Billings	2,000	Neg.
U.S. Gypsum Lewistown	Neg.	73
Westmoreland Hardin	unknown	19
Area Soures*		
Unpaved Roads	---	141,786
Agriculture	---	5,839
Open Burning	---	1,125
Other	2,007	3,662

*Only the counties of Yellowstone, Carbon, Stillwater, Sweetgrass and Big Horn

TABLE 2

Billings Air Quality Control Region - Region 140
Selected Stations Ambient Air Quality Data - 1977

Site	Sulfur Dioxide (Parts Per Million) Max. 24-Hour	Arith. Aver.	Particulates (Micrograms Per Cubic Meter) Max. 24-hour	Geo. Aver.*
Lockwood School	0.135	0.027	166.0	47.7
City Hall	---	---	165.0	57.9
Grand Ave. School	---	---	155.0	43.6
Montana & N. 27th	0.02	0.002	---	---
Farm E. Cenex	0.25	0.052	---	---

*Geometric Average

B. Great Falls Air Quality Control Region - Region 141

The annual arithmetic average of total suspended particulates for Region 141 during 1977 was 72.9 micrograms/cubic meter. This region contains nine counties and one major metropolitan area with much of the region remaining sparsely populated. The Region 141 had a 1970 census of 144,070 with 49 percent of these residing in the metropolitan area of Great Falls. In the Great Falls area, the maximum annual geometric average recorded was 88.8 micrograms/cubic meter and the maximum 24-hour measurement recorded was 869 micrograms/cubic meter. Only three particulate monitors were operated in the region, therefore, leaving large areas as having unknown particulate levels. Sulfur dioxide was not measured in the Great Falls region during 1977. Table 4 summarizes particulate data for selected sites in the region. The federal primary ambient particulate standard was exceeded four times during 1977 and the Montana ambient particulate standard was exceeded six times. Figure 3 shows graphically the trend of the particulate levels at the two longest operating stations in the Great Falls area. The graph shows that generally over the last four years particulate concentrations have decreased on the annual basis but the maximum twenty-four concentration is highly variable.

Primary industries in this region are cattle ranching, wheat farming, and oil and gas activities in the northwestern and northeastern areas of the region. A small petroleum refinery is located at Cut Bank. Two large grain processing plants are located at Great Falls. The only other major source of sulfur dioxide in the region is the refinery at Great Falls. These four plants are listed in Table 3 with estimated emissions. Also shown in Table 3 are the area source emissions for the AQCR.

FIGURE 3

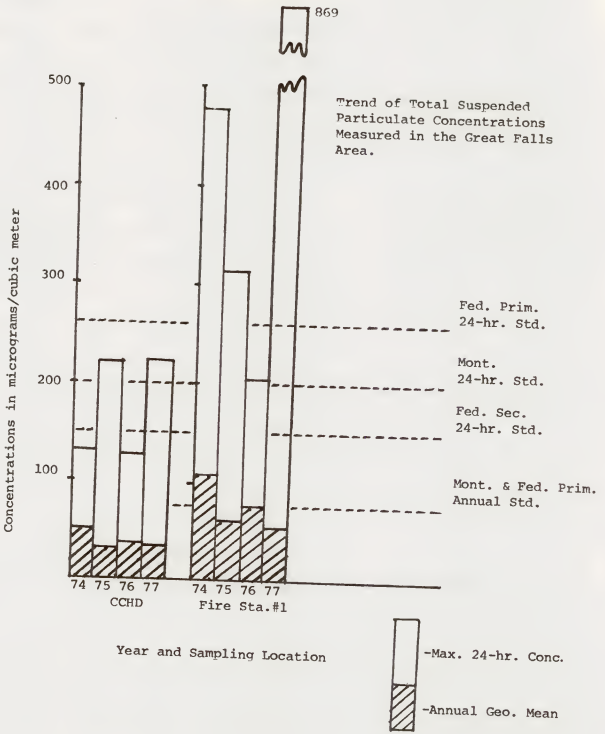

869
500
400
300
200
100
Concentrations in micrograms/cubic meter
Trend of Total Suspended Particulate Concentrations Measured in the Great Falls Area.
Fed. Prim. 24-hr. Std.
Mont. 24-hr. Std.
Fed. Sec. 24-hr. Std.
Mont. & Fed. Prim. Annual Std.
74 75 76 77
CCHD
74 75 76 77
Fire Sta.#1
Year and Sampling Location
-Max. 24-hr. Conc.
-Annual Geo. Mean

TABLE 3

Great Falls Air Quality Control Region - Region 141
Major Sources Estimated Emissions - 1977

Sources	Estimated Emissions (Tons Per Year) Sulfur Dioxide	Particulates
Point Sources		
Con-Agra Great Falls	0	70
General Mills Great Falls	0	32
Phillips Petroleum Great Falls	1,807	72
Westco Refining Cut Bank	883	11
Area Sources	2,600	251,000

TABLE 4

Great Falls Air Quality Control Region - Region 141
Selected Stations Ambient Air Quality Data - 1977

Site	Sulfur Dioxide (Parts Per Million) Max. 24-Hour	Arith. Aver.	Particulates (Micrograms Per Cubic Meter) Max. 24-Hour	Geo.Aver.
Cascade Co. Health Dept.	---	---	225	34.4
Fire Station #1	---	---	869	52.4

C. Helena Air Quality Control Region - Region 142

The arithmetic average of total suspended particulates for Region 142 during 1977 was 50.8 micrograms/cubic meter. The region contains 12 counties and several metropolitan areas. The region had a 1970 census of 167,100. The three major metropolitan areas where significant monitoring was conducted are Helena, Butte and Anaconda. The area of highest annual particulate levels was Butte with one station having a geometric average of 92.7 micrograms/cubic meter with a maximum 24-hour level of 297 micrograms/cubic meter. Due to the location of two large sources of sulfur dioxide in the region, the measurements for sulfur dioxide were orientated toward these sources and are not representative of the entire region. The Helena area monitors had an annual average sulfur dioxide concentration of 0.018 parts per million. The maximum 24-hour reading was 0.26 parts per million. In the Anaconda area, the annual average of sulfur dioxide monitors was 0.025 parts per million. The maximum 24-hour reading was 0.77 parts per million. The ambient particulate standards were violated on many occasions in the Butte area and on less occasions elsewhere in the region. The federal and Montana ambient sulfur dioxide standards were violated at several locations in the Helena and Anaconda areas. Table 6 summarizes sulfur dioxide and particulate data for selected sites in the region. Figure 4 shows graphically the trend of particulate levels at three of the longest operating stations in the Helena AQCR. The results differ with each area sampled. Concentrations are highly variable for the maximum concentrations measured.

Figure 5 shows graphically the trend of sulfur dioxide levels at three of the longest running sites in East Helena and Anaconda. The Anaconda site shows generally increasing levels of sulfur dioxide while the East Helena sites show a varied trend with no obvious pattern.

The majority of the point sources of air pollution in Region 142 are wood processing operations including some 14 sawmills with tepee burners. Emissions from these sources include mainly particulates, hydrocarbons and carbon monoxide. The two largest pollution sources in the region, however, are a lead smelter and a copper smelter. Emissions from these sources dominate the sulfur dioxide levels in the Helena and Anaconda areas. These sources emit large quantities of carbon monoxide, sulfur dioxide and particulates. Another large pollution source in this region is the Berkeley open pit mine. The major emissions from the mine are particulates, hydrocarbons, and oxides of nitrogen.

The region also contains one elemental phosphorous plant. This source releases mainly fluoride, particulates and sulfur dioxide into the air. Two cement plants and two talc plants are also located in the region. These plants emit mainly particulates and oxides of nitrogen. The region also contains many smaller air pollution sources which contribute to the overall pollution level. These include hot mix plants, incinerators, agricultural burning, motor vehicles and unpaved roads. Table 5 lists the estimated emissions from these and other sources in the region.

FIGURE 4

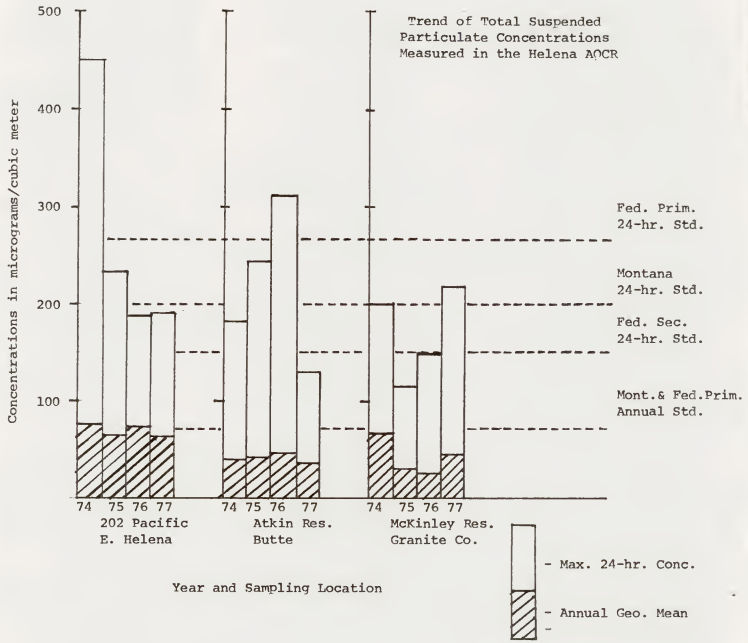

Trend of Total Suspended Particulate Concentrations Measured in the Helena AQCR
Concentrations in micrograms/cubic meter
500
400
300
200
100
Fed. Prim. 24-hr. Std.
Montana 24-hr. Std.
Fed. Sec. 24-hr. Std.
Mont.& Fed.Prim. Annual Std.
74 75 76 77
202 Pacific E. Helena
74 75 76 77
Atkin Res. Butte
74 75 76 77
McKinley Res. Granite Co.
Year and Sampling Location
- Max. 24-hr. Conc.
- Annual Geo. Mean

FIGURE 5

Trend of Sulfur Dioxide Measured
in the Helena AQCR

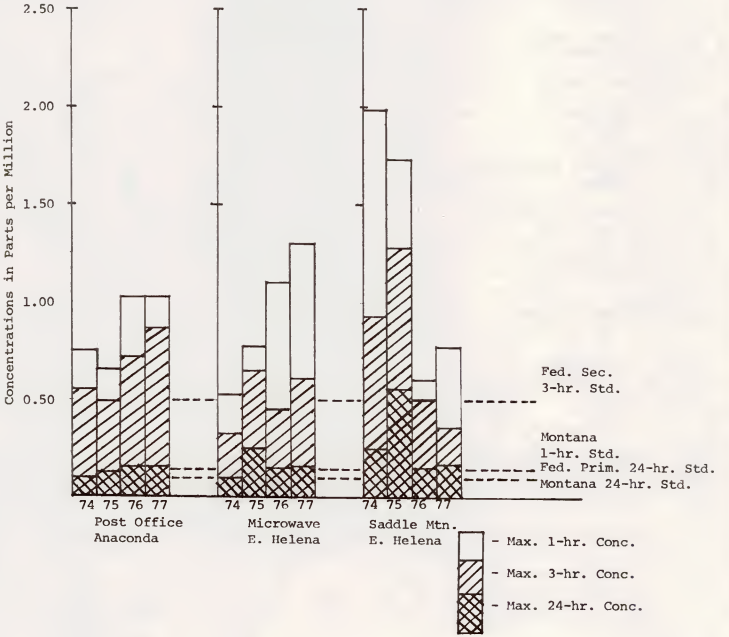


TABLE 5

Helena Air Quality Control Region - Region 142
Major Sources Estimated Emissions - 1977

Sources	Estimated Emissions (Tons Per Year) Sulfur Dioxide	Particulates
American Smelting & Refining Co. Esat Helena	80,000	265
Anaconda Company Anaconda	321,136	10,192
Kaiser Cement Montana City	---*	204
Ideal Cement	---*	263
Pfizer Dillon	5	124
Berkeley Open Pit Mine Butte	207	6,080
Stauffer Chemical Co. Silver Bow	208	73
U. S. Plywood Silver City	1	13
Townsend Lumber Townsend	1	20
Yellowstone Pine Belgrade	1	15
Elk Studs West Yellowstone	1	12
Burkland Studs Livingston	1	12
Area Sources+		
Unpaved Roads	---	81,278
Agriculture	---	101
Open Burning	---	7,047
Other	977	2,816

*Unknown at this time
+Only the counties of Lewis & Clark, Deer Lodge, and Silver Bow

TABLE 6

Helena Air Quality Control Region - Region 142
Selected Stations Ambient Air Quality Data - 1977

Site	Sulfur Dioxide (Parts Per Million) Max 24-hour	Arith. Aver.	Particulates (Micrograms Per Cubic Meter) Max. 24-hour	Geo. Aver.
212 E. Pacific St. E. Helena	---	---	192.0	66.7
Saddle Mtn. E. Helena	0.17	0.012	---	---
Microwave E. Helena	0.14	0.012	103.0	22.5
Broudy Farm E. Helena	0.26	0.037	---	---
C-Hill Anaconda	0.64	0.023	---	---
Hi-Way Jct. Anaconda	0.77	0.038	161.0	43.9
Atkins Butte	---	---	130.0	30.6
McKinley Res Granite Co.	---	---	217.0	44.6
Tierney Res. Silver Bow Co.	---	---	89.0	31.5
Greely School Butte	---	---	233.0	78.7

D. Miles City Air Quality Control Region - Region 143

The annual arithmetic mean for total suspended particulates for Region 143 for 1977 was 26.8 micrograms/cubic meter with a maximum 24-hour level of 275 micrograms/cubic meter. The region contains 17 counties, all of which are fairly sparsely populated. The region has a total population of 97,554. Increased activity is present in this region as it contains major coal fields. Sulfur dioxide was monitored at several locations in the region but little or no sulfur dioxide was detected. Table 8 summarizes sulfur dioxide and particulates data for selected sites in the region from state run monitors.

Primary industries in this region consist of cattle ranching, farming, oil and gas production, and coal mining. Estimated emissions from the major sources in the region are listed in Table 7. The three largest emitters in the region are the three power plants presently operating. At Colstrip two 350 megawatt power plants are operating while a smaller power plant is operating at Sidney.

TABLE 7

Miles City Air Quality Control Region - Region 143
Major Sources Estimated Emissions - 1977

Sources	Estimated Emissions (Tons Per Year) Sulfur Dioxide	Particulates
Holly Sugar Company Sidney	226	116
Montana Power Co. Unit #1 & #2 Colstrip	5326	618
Montana-Dakota Utilities Sidney	2372	348
Tumpane Co. Glasgow AFB	174	29
Area Sources*		
Unpaved Roads	----	81,170
Agriculture	---	4,068
Open Burning	----	803
Other	596	1,427

*Only the counties of Rosebud, Treasure, Custer, Fallon, Powder River and Carter

TABLE 8

Miles City Air Quality Control Region - Region 143
Selected Stations Ambient Air Quality Data - 1977

Site	Sulfur Dioxide (Parts Per Million) Max. 24-hour	Arith. Aver.	Particulates (Micrograms Per Cubic Meter) Max. 24-hour	Geo. Aver.
BN Site Colstrip	0.0	0.0	95.0	25.0
Littlefield Miles City	---	---	45.0	15.5
Broadus Powder River Co.	---	---	275.0	14.4
Lindsay Dawson Co.	---	---	156.0	27.9
Fort Peck McCone Co.	0.0	0.0	88.0	16.4
Glendive Dawson Co.	---	---	51.0	19.1

E. Missoula Air Quality Control Region - Region 144

The annual arithmetic mean for total suspended particulates for Region 144 during 1977 was 64.6 micrograms/cubic meter. The region consists of 7 counties with a population of 154,691. The major metropolitan area is Missoula, which also recorded the second highest 24-hour particulate level of 335 micrograms per cubic meter. One monitor in Columbia Falls had an annual geometric average of 82.8 micrograms/cubic meter with the maximum 24-hour level being 467 micrograms/cubic meter. High levels were also recorded in the Kalispell and Libby areas. Sulfur dioxide was not measured during 1977 in Region 144 as no large sources of sulfur dioxide are located in the area. Violations of federal and Montana ambient particulate standards were measured at several locations mainly around the urban areas. Missoula recorded the greatest number of particulate matter violations. Table 10 summarizes particulate data for selected sites in the region.

The majority of the point sources of air pollution in Region 144 are wood processing operations - some 25 sawmills with tepee burners or wood waste boilers, 5 plywood plants, 2 particleboard plants, a pulp mill, etc. Other sources include an aluminum reduction plant, vermiculite plant and several aggregate processing plants. The emissions from these sources are primarily particulate matter, but the aluminum plant emits large quantities of fluoride and the pulp mill is a significant source of various odorous sulfide compounds.

There are a number of other sources of particulate matter which individually are small but cumulatively can contribute considerably to the total particulate emissions. Included in this group are incinerators, agricultural burning, small heating plants, small manufacturing operations, motor vehicles and others. Probably the two most conspicuous of these "area" sources are forest slash burning and unpaved roads.

Table 9 summarizes emission estimates from the major point and area sources in the region.

Figure 6 shows graphically the trend of particulate levels at two sites in the Missoula area. Both sites show similar patterns with no obvious trend shown.

FIGURE 6

Trend of Total Suspended Particulate Concentrations Measured in the Missoula Area

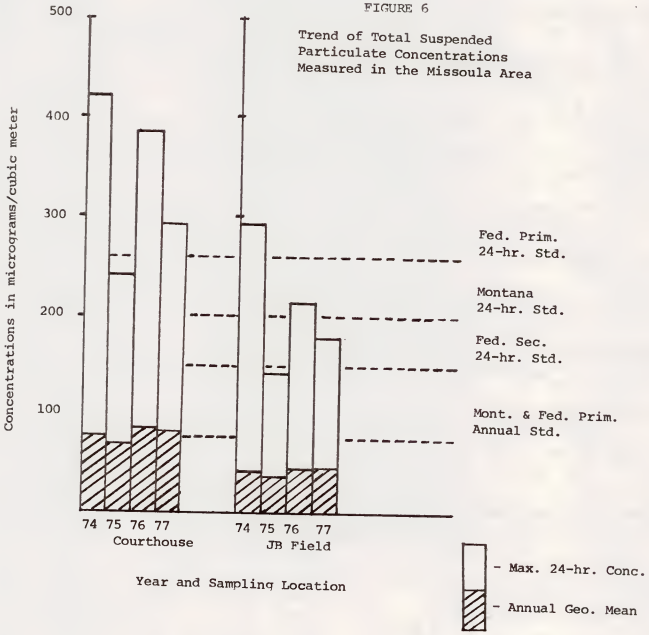


TABLE 9

Missoula Air Quality Control Region - Region 144
Major Sources estimated emissions - 1977

Sources	Estimated Emissions (Tons Per Year) Sulfur Dioxide	Particulates
Point Sources		
Anaconda Aluminum Columbia Falls	---*	1,560
Louisiana-Pacific (particleboard) Missoula	NEG	92
Evans Products (plywood) Missoula	24	37
W. R. Grace Libby	700	4.5
Champion-Hoerner Waldorf Missoula	910	755
Plum Creek Lumber Columbia Falls	65	34
St. Regis Paper Libby	277	696
Champion-U.S. Plywood Bonner	224	288
Area Sources+		
Unpaved Roads	---	158,386
Agriculture	---	245
Open Burning	---	13,643
Other	3,282	3,221

*Unknown at this time
+Only for the Counties of Flathead, Lake and Missoula

TABLE 10

Missoula Air Quality Control Region - Region 144
Selected Stations Ambient Air Quality Data - 1977

Site	Sulfur Dioxide (Parts Per Million) Max.	24-hour	Arith. Aver.	Particulates (Micrograms Per Cubic Meter) Max.	24-Hour	Geo. Aver.
Courthouse Missoula	---		---	295.0		82.8
JB Field Missoula	---		---	180.0		45.8
Anders Columbia Falls	---		---	467.0		92.9
Sverdrup Libby	---		---	119.0		42.6

III. SPECIAL STUDY AREA WORK

III. SPECIAL STUDY AREA WORK

In the Billings AQCR a special study was continued in the Billings-Laurel metropolitan area. This study was conducted for both population and point-source type air pollution sources. The major sources are refineries, chemical and sugar companies and a power plant. Results of the studies indicated violations of the federal primary and state sulfur dioxide, the federal secondary particulate and the federal primary carbon monoxide standards. Violations of the state ambient standard for sulfation rate were also recorded.

In Great Falls AQCR a population orientated study was continued in the Great Falls metropolitan area. The Great Falls area study resulted in violations of the state standard for total dustfall and sulfation rate and violations of the federal primary and state particulate standards.

In the Helena AQCR special studies were conducted around various large point sources. In the Helena area, monitoring around the lead smelter resulted in violations of the federal secondary particulate standard. Also violations of the federal primary and state sulfur dioxide standards were recorded at several locations. The state sulfation rate ambient standard was also violated. In the Anaconda area, monitoring around the copper smelter resulted in violations of the federal primary and state sulfur dioxide standards being recorded. The state sulfation rate ambient air standard was also violated. In the Butte area monitoring was mainly conducted for emissions from the large open pit mine. Results of monitoring in this area indicated frequent violations of the federal secondary and state particulate standards.

In the Miles City AQCR, special studies were conducted for establishing background levels of pollutants in the coal development areas. Monitoring was also conducted around the two large power plants at Colstrip. Violations

of the ambient air particulate standards were recorded on company run monitors. Ozone levels approached the federal primary standard on monitors operated by the state.

In the Missoula AQCR, special studies were continued in the Missoula metropolitan area and the Columbia Falls area. In the Missoula area the study was conducted for population and point-source type air pollution sources. The majority of these sources were wood products related. The results of sampling in the area indicated violations of the federal primary and state particulate standards. In the Columbia Falls area monitoring was conducted around an aluminum reduction plant. Results of the sampling indicated violations of the state fluoride standard. Sampling was also conducted in various areas of western Montana around local air pollution sources. Violations of the federal and state particulate standards were recorded.

More detailed analyses of the special studies are presented in the following sections.

Billings-Laurel Area

In Region 140 a special study was continued in the metropolitan area of Billings and Laurel. This study was conducted by the Yellowstone County Air Pollution Control and the DHES. It was conducted both for population and point-source type air pollution sources. The major sources monitored were a power plant and three refineries. Table 11 summarizes the estimated emissions from the major point sources.

Air pollutants measured consisted of total suspended particulates, sulfur dioxide, sulfation rate, carbon monoxide, hydrocarbons, ozone, and nitrogen dioxide. The maps in Figures 7 and 8 illustrate the approximate locations of the major point sources and the air pollution monitors.

The results of the ambient sampling, summarized in Tables 12 through 15, indicate violations of federal secondary particulate standards, federal primary carbon monoxide standard and state and federal primary sulfur dioxide standards. Violations of the state ambient standard for sulfation rate were also recorded. The minimum particulate levels were recorded at the City Hall and Lockwood School sites. The City Hall site recorded a maximum 24-hour value of 165 micrograms per cubic meter (ug/m^3) and a geometric mean of 57.9 ug/m^3. The Lockwood School site recorded a maximum 24-hour value of 166 ug/m^3 and a geometric mean of 47.7 ug/m^3. Higher concentrations were recorded at the Burnstead Dr. site but this station was only operated for four months during 1977. The carbon monoxide federal 8-hour standard was exceeded at the Montana and N. 27th site. The maximum 8-hour reading was 13.12 parts per million (ppm). The federal ozone standard was not exceeded at the Montana & N. 27th site. The maximum 1-hour reading was 0.08 ppm. The nitrogen dioxide standard was also approached but not exceeded. The annual average nitrogen dioxide concentration at the Montana & N. 27th site was 0.029 ppm. Sulfur dioxide

measurements resulted in concentrations being recorded in excess of all state and federal standards at one or more sites. The highest concentrations were recorded around the Laurel refinery with maximum 1-hour, 3-hour and 24-hour concentrations of 0.63, 0.45 and 0.25 ppm, respectively. The Laurel Farm E. of Cenex and E. of Laurel sites recorded highest average sulfation rate values with both sites exceeding the Montana standard frequently. The sites recorded maximum values of 4.38 and 3.22 mg $SO_3/100\ cm^2/day$, respectively.

Tables 14 and 15 also show average concentrations of pollutants for 1976, 1975, and 1974 for comparison. Tables 16 and 17 show a monthly frequency wind rose for the wind sensor located in the Laurel area.

The Billings area is the subject of an Air Quality Maintenance Plan for the maintaining of particulate and sulfur dioxide levels within the ambient standards through 1985. The Billings area was also classified as a non-attainment area for carbon monoxide, sulfur dioxide (primary), and particulates (secondary).

TABLE 11

BILLINGS-LAUREL AREA MAJOR SOURCES
Estimated Emissions

Point Source	Pollutant (Tons Per Year)					
	SO_2	Part.	NOx	HC	CO	F
Cenex	11,830	398	540	1,082	31	3
Conoco	3,198	263	1,041	1,936	540	3
Exxon	9,800	932	1,401	1,132	2	3
Great Western Sugar Co.	815	65	337	2	11	Neg.
Montana Power Co.	9,986	1,197	6,757	113	375	9
Montana Sulphur & Chem.	2,000	Neg.	4	Neg.	Neg.	---

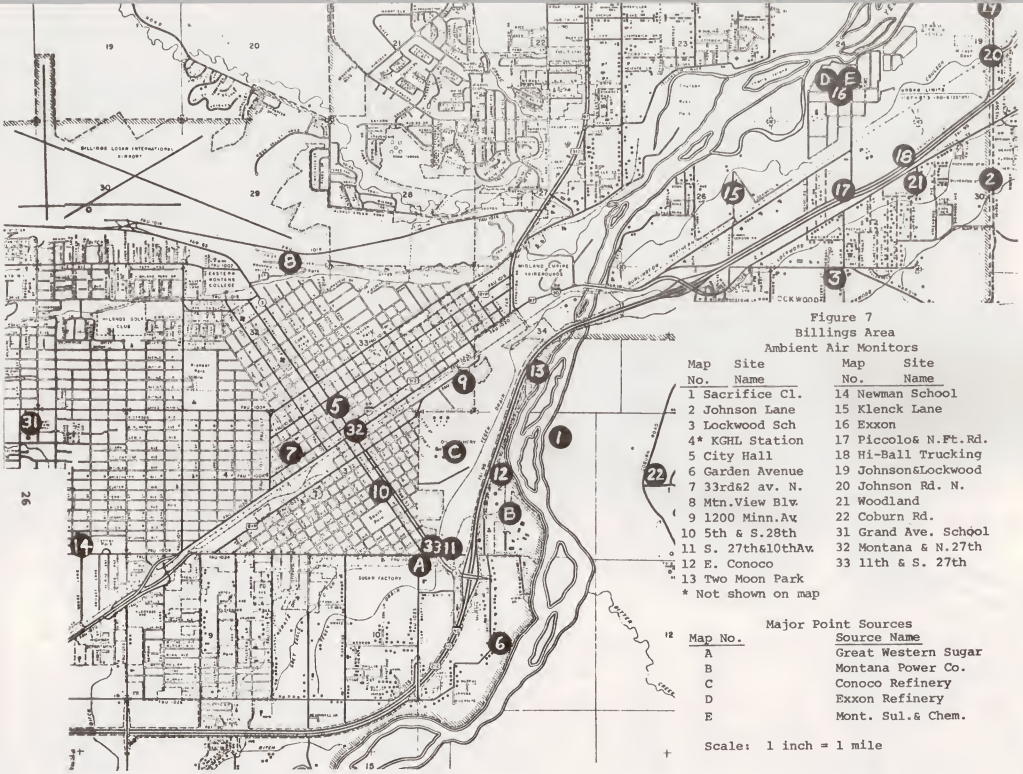


Figure 7
Billings Area
Ambient Air Monitors

Map No.	Site Name	Map No.	Site Name
1	Sacrifice Cl.	14	Newman School
2	Johnson Lane	15	Klenck Lane
3	Lockwood Sch	16	Exxon
4*	KGHL Station	17	Piccolo& N.Ft.Rd.
5	City Hall	18	Hi-Ball Trucking
6	Garden Avenue	19	Johnson&Lockwood
7	33rd&2 av. N.	20	Johnson Rd. N.
8	Mtn.View Blv.	21	Woodland
9	1200 Minn.Av.	22	Coburn Rd.
10	5th & S.28th	31	Grand Ave. School
11	S. 27th&10thAv.	32	Montana & N.27th
12	E. Conoco	33	11th & S. 27th
13	Two Moon Park		

* Not shown on map

Major Point Sources

Map No.	Source Name
A	Great Western Sugar
B	Montana Power Co.
C	Conoco Refinery
D	Exxon Refinery
E	Mont. Sul.& Chem.

Scale: 1 inch = 1 mile

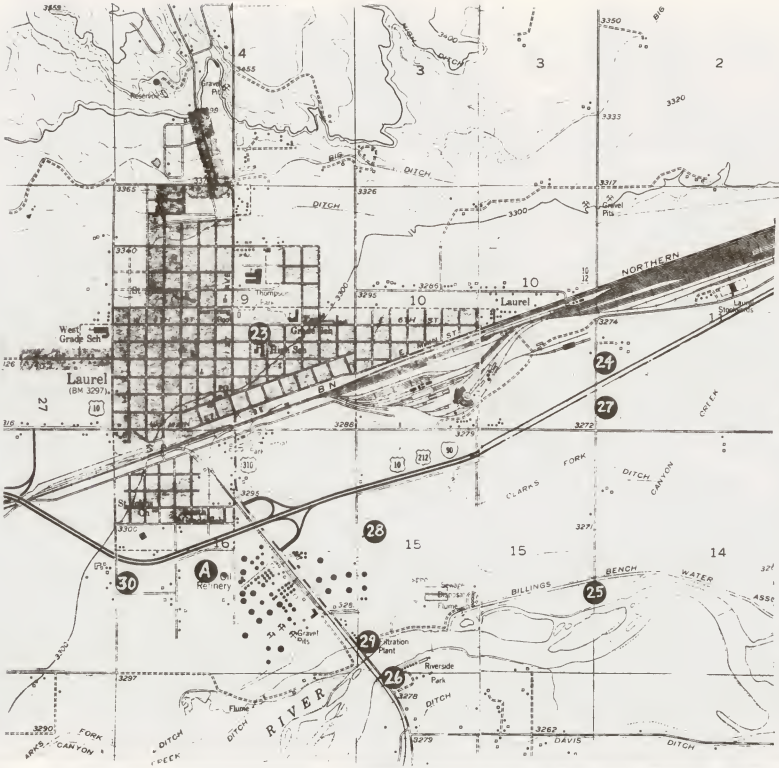


FIGURE 8

Laurel Area
(Yellowstone Co.)

Ambient Air Monitors

Map No.	Site Name
23	Laurel Jr. High
24	1 Mi. NE Coop
25	3/4 Mi. W Coop
26	½ Mi. S Coop
27	E. of Laurel
28	Laurel Farm
29	Water Plant
30	West Coop

Major Point Source

Map No.	Source Name
A	Cenex Refinery

Scale: 1 inch = 1 mile

TABLE 12
TOTAL SUSPENDED PARTICULATE DATA YEARLY SUMMARY YELLOWSTONE COUNTY
Jan. 1977 - Dec. 1977
Values in micrograms per cubic meter

Station*	Minimum	Frequency Distribution (Concentration equal to or less than stated %) 10%	30%	50%	70%	90%	95%	98%	Maximum	Arith. Mean	Arith. Std. Dev.	Geo. Mean	Geo. Std. Dev.	Total No. Obs.	Number of Samples Reported per Month: Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Lockwood Sch.	16	20	33	50	64	93	109	137	166	55.4	31.17	47.66	1.37	59	5	4	5	5	6	5	5	5	5	5	4
KHGL Station	3	20	25	31	42	58	74	87	163	38.3	23.90	32.49	1.45	60	5	4	5	5	6	5	5	5	5	5	5
City Hall	21	38	48	57	70	91	98	151	165	62.7	26.93	57.88	1.17	57	3	4	5	5	6	5	4	5	5	5	5
Grand Ave Sch	4	11	40	48	55	82	101	144	155	52.7	30.48	43.57	1.64	55	3	2	4	5	6	5	5	5	5	5	5
Laurel Jr. Hi	10	18	30	39	46	60	67	106	150	41.2	22.92	36.46	1.29	54	4	2	4	4	5	5	5	5	5	5	5
Burnstead Dr	50	50	62	187	466	687	687	688	688	306.8	250.92	202.96	2.90	11	2	1	4	4	0	0	0	0	0	0	0

* See Figures 7 and 8

TABLE 13
CONTINUOUS MONITOR DATA
Yearly Summary Yellowstone County
Values in Parts Per Million

Site	Map* No.	Pollutant	Maximum Reading 1-Hour	3-Hour	8-Hour	24-Hour	Arith. Aver.	Standards Exceeded 1-Hour	3-Hour	8-Hour	24-Hour -
Montana & N. 27th	32	Carbon Monoxide	19.20	17.40	13.12	---	2.316	0	---	3	---
		Total Hydrocarbons	26.40	25.30	---	16.22	3.071	--	---	---	---
		Nitrogen Dioxide	0.18	0.15	---	0.10	0.029	--	---	---	---
		Ozone	0.08	0.15	---	0.04	0.018	0	---	---	---
		Sulfur Dioxide	0.17	0.11	---	0.02	0.002	0	0	---	0
Laurel Farm E of Cenex	28	Sulfur Dioxide	0.63	0.45	---	0.25	0.052	276	0	---	32

* See Figures 7 and 8

TABLE 14

Sulfur Dioxide Bubbler Data
Yearly Summary Yellowstone Co.
Values in parts per million

Site	Map* No.	Geometric Mean	Arithmetic Mean	Maximum 24-Hour Value	1976 A. Mean	1975 A.Mean
Lockwood School	3	0.0034	0.0269	0.1351	0.0223	0.0089

TABLE 15

Sulfation Rate Data Yearly Summary Yellowstone County
Values in milligrams sulfur trioxide per 100 square centimeters per day

Site	Maps* No.	Max.	Annual Aver.	No. Samples	Months Standard Exceeded	1976 Aver.	1975 Aver.	1974 Aver.
Sacrifice Cliff	1	1.11	0.62	5	3	0.74	0.42	0.28
Lockwood School	3	1.71	0.84	10	6	0.78	0.37	0.26
Johnson Lane	2	1.85	0.87	10	6	0.57	0.28	0.24
KGHL Station	4	0.84	0.41	11	4	0.	0.21	0.09
City Hall	5	0.65	0.31	11	2	0.	0.16	0.04
Garden Avenue	6	0.61	0.24	11	2	0.03	0.14	0.06
CNR 33 & 2 Ave. N.	7	0.45	0.13	11	0	0.04	0.04	0.03
Mtn. View Blvd.	8	0.56	0.28	11	1	0.09	0.03	0.04
1200 Minn. Ave.	9	1.18	0.60	11	7	0.53	0.23	0.19
5th & S. 28th	10	0.65	0.31	11	3	0.10	0.07	0.10
S. 27th & 10 Ave. Sl.	11	1.26	0.52	11	4	0.18	0.14	0.12
East Conoco	12	1.32	0.55	11	5	0.35	0.43	0.23
Two Moon Park	13	1.36	0.80	11	10	0.41	0.29	0.15
Newman School	14	0.58	0.24	6	1	0.18	0.12	0.05
Klenck Lane	15	1.04	0.42	8	2	0.44	0.30	0.14
Exxon	16	1.55	1.02	10	9	0.82	0.57	0.45
Piccolo & N Ft. Rd.	17	1.78	1.15	10	8	0.97	0.70	0.41
Hi-Ball Trucking	18	1.84	1.27	10	10	0.88	0.72	0.41
Johnson & Lockwood	19	1.88	1.00	10	8	0.74	0.54	0.36
Johnson Rd. N.	20	1.85	1.17	10	10	0.98	0.72	0.38
Woodland	21	1.45	0.76	10	6	0.77	0.50	0.34
Coburn Road	22	2.16	0.95	9	8	0.92	0.64	0.29
Laurel Jr.Hi.	23	0.38	0.12	10	0	0.02	0.02	0.01
1 Mi. NE Coop	24	2.62	0.90	11	6	0.83	0.47	0.32
3/4 Mi. W of Coop	25	1.51	0.85	11	8	0.58	0.38	0.37
1/2 Mi. S of Cenex	26	1.78	1.17	11	11	0.72	---	0.30
E. of Laurel	27	3.22	1.79	9	9	1.47	1.03	0.63
Laurel Farm E. Cenex	28	4.38	2.34	11	11	2.65	1.72	1.19
West Coop	30	0.64	0.31	11	2	0.23	0.23	0.08

* See Figures 7 and 8

TABLE 16

MONTHLY SUMMARY OF SURFACE WIND DIRECTION

Laurel-Farm E. Cenex Site 1977
(Values in percent of occurrence)

Direction	Jan	Feb	Mar	Apr*	May	Jun	Jul	Aug	Sep*	Oct*	Nov	Dec*
N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	-	0.0
NNE	2.6	0.9	2.5	5.0	1.3	0.7	2.2	-	2.0	0.7	-	0.4
NE	5.5	0.9	2.9	3.2	1.9	4.1	7.1	-	2.3	5.1	-	0.8
ENE	12.2	1.4	7.3	8.2	11.4	11.3	21.9	-	20.7	18.7	-	4.1
E	5.5	1.0	4.1	5.9	7.0	7.4	8.2	-	7.6	6.0	-	4.6
ESE	3.2	2.6	3.5	7.3	8.3	13.9	8.9	-	5.0	5.3	-	15.4
SE	0.4	0.0	1.4	1.5	1.6	3.3	2.2	-	0.3	0.5	-	5.0
SSE	1.7	0.3	3.0	4.4	2.8	3.7	3.9	-	4.3	2.5	-	3.7
S	0.9	2.7	3.9	8.5	7.1	6.5	4.8	-	9.3	3.7	-	2.1
SSW	12.0	8.2	10.0	12.0	13.2	12.2	7.8	-	8.1	9.4	-	0.4
SW	5.6	13.8	7.6	7.3	6.7	8.1	3.5	-	3.5	6.5	-	0.0
WSW	25.8	32.9	19.4	16.4	15.9	13.3	11.5	-	14.4	19.8	-	1.7
W	9.6	13.1	10.5	7.3	8.0	3.9	6.1	-	5.8	9.2	-	5.4
WNW	11.7	11.4	11.7	8.5	8.6	6.9	6.9	-	11.8	8.3	-	22.8
NW	1.7	4.3	5.6	3.2	2.8	2.2	1.5	-	3.0	2.3	-	18.7
NNW	1.7	6.6	6.8	1.2	3.6	2.4	3.5	-	2.0	2.1	-	14.9

*Only partial month's data

TABLE 17

MONTHLY SUMMARY OF SURFACE WIND SPEED

Laurel-Farm E. Cenex Site 1977
(Values in percent of occurrence)

	Jan	Feb	Mar	Apr*	May	Jun	Jul	Aug	Sep*	Oct*	Nov	Dec*
Speed (m/sec)												
0.1-1.5	20.5	10.9	23.1	30.8	27.4	41.1	34.9	-	44.6	26.3	-	15.4
1.6-3.0	19.7	21.8	29.2	41.3	36.7	38.9	34.3	-	32.0	28.3	-	17.4
3.1-5.0	33.1	42.1	26.9	22.6	26.8	15.6	25.0	-	16.4	30.9	-	50.2
5.1-8.0	20.1	24.2	17.1	5.0	7.1	4.1	4.6	-	5.5	13.4	-	15.8
8.1-10.0	6.6	1.0	2.9	0.3	0.9	0.0	0.7	-	0.8	0.0	-	0.4
10.1-14.0	0.0	0.0	0.8	0.0	0.7	0.0	0.2	-	0.0	0.0	-	0.0
14.1-18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	-	0.0
18.1-22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	-	0.0
Over 22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	-	0.0
Calm	0.0	0.0	0.0	0.0	0.4	0.4	0.2	-	0.8	1.2	-	0.8
Aver. Speed (m/sec)	3.9	4.0	3.4	2.5	2.8	2.2	2.4	-	2.1	2.9	-	3.5

*Only partial month's data

Great Falls Area

In Region 141, a study was continued in the Great Falls area by the Cascade County Air Pollution Control. This study was conducted both for population and point-source type air pollution sources. The major industrial sources are two grain mills and a refinery. Table 18 summarizes emission estimates for these and other sources.

Sampling was performed for particulate matter (total dustfall and total suspended particulates) and sulfation rate. Results are summarized in Tables 19 through 21. The maps (Figures 9 and 10) indicate the relative location of the air monitors. The results of the sampling indicate violations of federal primary and state total suspended particulate standards and the state sulfation rate standard. Violations of the state standard for total dustfall were also measured. The maximum particulate levels were recorded at Fire Station #1 site with a maximum 24-hour reading of 869 micrograms per cubic meter and a geometric mean of 52.4 micrograms per cubic meter. Maximum sulfation rate values were recorded at the Phillips Refinery N-1 site with a maximum value of 0.63 mg SO_3/100 cm^2/day. The Mountain States site recorded the highest total dustfall readings with a one-month maximum of 80.6 tons/square mile.

Tables 20 and 21 also show the average concentrations of pollutants for 1976, 1975 and 1974 for comparison.

Great Falls area has also been designated as a non-attainment area for particulates (secondary).

TABLE 18

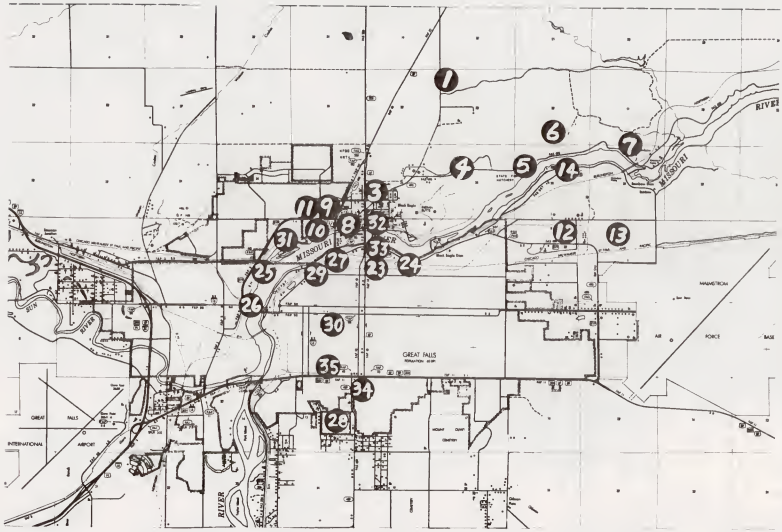
Great Falls Area Major Sources
Estimated Emissions

Point Source	Pollutant (Tons Per Year) SO_2	Part.	NO_x	HC	CO
Con-Agra	0	70	Neg.	Neg.	Neg.
General Mills	0	32	Neg.	0	0
Phillips Petroleum	1807	72	142	1404	10,579

FIGURE 9

Great Falls Area

Ambient Air Monitors



Map No.	Site Name
1	ACM North
3	Stock Car Track
4	ACM East #1
5	Giant Springs
6	Mt. Power Subst
7	Rainbow
8	Phillips Ref E
9	Phillips Ref N
10	Phillips Ref S
11	Phillips Ref N
12	Conoco W
13	Conoco E
14	River Road
23	Super America
24	Mountain States
25	Fairgrounds
26	Central West
27	J & J Cafe
28	Cascade Co. H.D
29	City Sewage Pum
30	Fire Sta #1
31	K-Mart
32	15th St. Br. N.
33	15th St. Br. S.
34	Holiday Village
35	10th Ave. So.

Scale: 1 inch = 1.3 mile

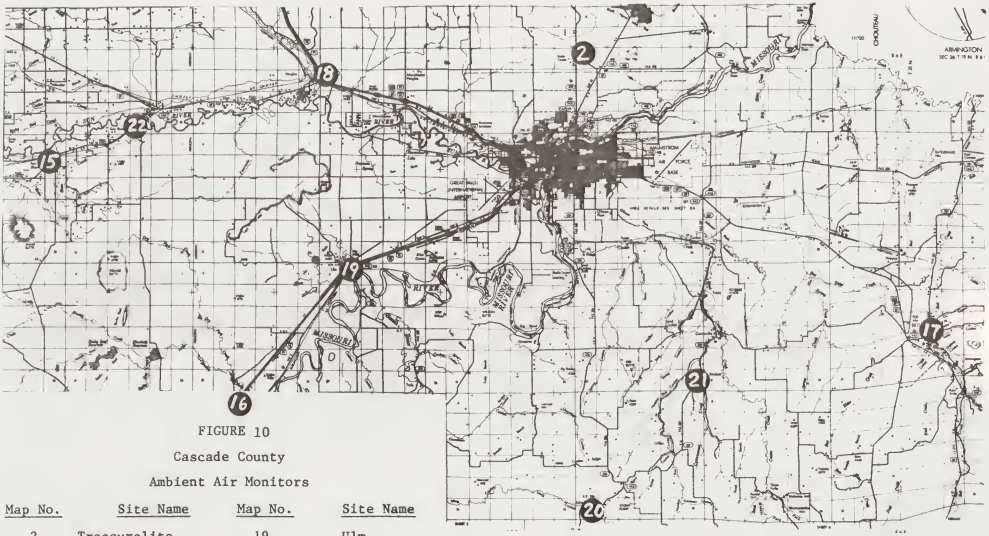


FIGURE 10

Cascade County

Ambient Air Monitors

Map No.	Site Name	Map No.	Site Name
2	Treasurelite	19	Ulm
15	Fort Shaw	20	Eden
16	Cascade Fire Hall	21	Stockett
17	Belt	22	Sun River
18	Vaughan		

Scale: 1 inch = 4 miles

TABLE 19

TOTAL SUSPENDED PARTICULATE DATA YEARLY SUMMARY CASCADE COUNTY

Jan. 1977 - Dec. 1977

Station*	Min.	10%	30%	50%	70%	90%	95%	98%	Max.	Arith. Mean	Arith. Std. Dev.	Geo. Mean	Geo. Std. Dev.	Total No. Obs.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Frequency Distribution (Concentration equal to or less than stated %)														Number of Samples Reported per Month											
10th Ave. So. Cascade Co.	32	48	75	92	116	245	272	328	411	118.19	82.88	99.40	1.38	34	0	0	0	0	0	0	4	10	9	2	3	6
Hospital Roof Great Falls	3	15	23	34	52	78	102	129	225	44.01	33.99	34.39	1.69	93	9	8	9	8	7	8	8	12	9	5	6	4
Fire Station #1 Great Falls	5	21	44	53	65	125	149	164	869	69.03	90.80	52.39	1.63	93	8	8	9	5	9	9	9	10	9	5	6	6

*See Figures 9 and 10

TABLE 20
Total Dustfall Data
Yearly Summary Cascade County
Values in Tons Per Square Mile

Site	Map* No.	Max.	Annual Aver.	No. Samples	Standard Exceeded	1976 Aver.	1975 Aver.	1974 Aver.
Treasurelite Plt.	2	5.91	3.00	7	0	3.93	12.55	15.15
Giant Springs	5	27.44	10.38	12	1	11.30	10.76	16.97
10th Ave South	35	64.89	30.53	4	2	---	---	---
Eden	20	4.21	3.49	6	0	7.90	5.15	9.10
Mountain States	24	80.64	26.96	12	9	22.21	26.84	24.26
Fairgrounds	25	31.46	12.46	11	3	8.70	11.56	12.22
Cascade Co.Hlth.Dpt.	28	15.00	6.48	12	0	7.75	7.96	7.68
Fire Station #1	30	31.17	16.21	11	6	18.86	14.05	18.45

* See Figures 9 and 10

Table 21
Sulfation Rate Data Yearly Summary Cascade County
Values in Milligrams Sulfur Trioxide Per 100 Square Centimeters Per Day

Site	Map* No.	Max.	Annual Aver.	Months No. Sample	Standard Exceeded	1976 Aver.	1975 Aver.	1974 Aver.
ACM North	1	0.24	0.06	11	0	0.05	0.11	0.36
Treasurelite	2	0.21	0.04	11	0	0.03	0.04	0.25
Stockcar Track	3	0.61	0.26	11	1	0.05	0.10	0.36
ACM East #1	4	0.27	0.11	11	0	0.04	0.10	0.22
Giant Springs	5	0.23	0.04	12	0	0.04	0.07	0.16
Mt. Power Substa.	6	0.27	0.10	12	0	0.06	0.08	0.24
Rainbow	7	0.16	0.07	7	0	0.01	0.06	0.13
Phillips Ref.E	8	0.58	0.34	12	2	0.14	0.25	0.72
Phillips Ref. N#1	9	0.63	0.42	10	2	0.13	0.29	0.87
Phillips Ref.S.	10	0.31	0.15	12	0	0.08	0.18	0.24
Phillips Ref.#2	11	0.46	0.17	11	0	0.07	0.15	0.24
Conoco W	12	0.19	0.04	12	0	0.04	0.06	0.12
Conoco E	13	0.15	0.05	12	0	0.05	0.06	0.11
Fort Shaw	14	0.10	0.01	10	0	0.04	0.03	0.08
Cascade Fire Hall	15	0.20	0.05	9	0	0.06	0.07	0.09
Belt	16	0.12	0.06	3	0	0.06	0.05	0.07
Vaughn	17	0.14	0.02	12	0	0.03	0.03	0.05
Ulm	18	0.17	0.04	11	0	0.05	0.04	0.07
Eden	19	0.17	0.05	6	0	0.02	0.01	0.03
Stockett	20	0.15	0.02	12	0	0.06	0.07	0.03
Sun River	21	0.20	0.03	11	0	0.03	0.02	0.03
Super America	22	0.18	0.08	9	0	0.08	0.06	0.19
Mountain States	23	0.17	0.05	12	0	0.07	0.09	0.32
Fairgrounds	24	0.12	0.03	10	0	0.04	0.04	0.06
Central West	25	0.39	0.08	12	0	0.05	0.05	0.06
J & J Cafe	26	0.31	0.13	12	0	0.07	0.09	0.14
Casc. Co. Hlth.Dept.	27	0.17	0.03	12	0	0.04	0.02	0.16
City Sewage Pump	28	0.15	0.06	11	0	0.05	0.07	0.11
Fire Station #1	29	0.18	0.03	11	0	0.03	0.04	---
K-Mart	30	0.16	0.07	12	0	0.09	0.04	---
15th St. Br. N.	31	0.37	0.23	11	0	0.06	0.11	---
15th St. Br. S.	32	0.28	0.11	10	0	0.06	0.06	---
Holiday Village	33	0.24	0.08	11	0	0.09	0.04	---
Park Drive	34	0.11	0.07	4	0	---	---	---
Holiday Inn	35	0.18	0.12	4	0	---	---	---
10th Ave. So.	36	0.11	0.03	5	0	---	---	---

*See Figures 9 and 10

Helena-East Helena Area

In Region 142 a special study was continued in the Helena-East Helena area jointly by the DHES and the Environmental Protection Agency. This study was orientated toward a lead smelter located near East Helena. The lead smelter is a source of sulfur dioxide, particulates and carbon monoxide (see Table 5).

Sampling was performed in the area for sulfur dioxide, particulate matter and sulfation rate (indicator of sulfur dioxide and other sulfur compounds). Tables 23 through 27 summarize the data obtained in the study. Figure 11 (refer also to Table 22) shows the location of the source and the air monitors. Violations of the federal secondary particulate standard were recorded. Also violations of the federal primary and state sulfur dioxide standards were recorded at several locations. The state sulfation rate ambient standard was also violated. The maximum particulate levels were recorded at the 212 Pacific Street site with a maximum 24-hour value of 192 micrograms per cubic meter and a geometric mean of 66.7 micrograms per cubic meter. The maximum sulfur dioxide levels were recorded at the Microwave, Saddle Mountain and Broudy sites. The maximum 24-hour readings recorded were 0.16, 0.17 and 0.26 ppm, respectively. Highest average sulfation rate values were recorded at the East Station site, with a maximum value of 0.69 mg SO_3/100 cm^2/day. Tables 26 and 27 also summarize the wind data collected during 1977 at the Microwave site in the East Helena area.

The lead smelter is on a program which will control both particulate matter and sulfur dioxide from the sintering operations. The smelter has installed a 500 T/day sulfuric acid plant which will ultimately control 75% of the sulfur dioxide emissions. The sulfur dioxide emissions will decrease from approximately 80,000 T/yr to approximately 370-375 T/yr. The smelter is also installing a baghouse which will control particulate emissions.

The East Helena area has also been designated as a non-attainment area for sulfur dioxide (primary) and particulates (secondary).

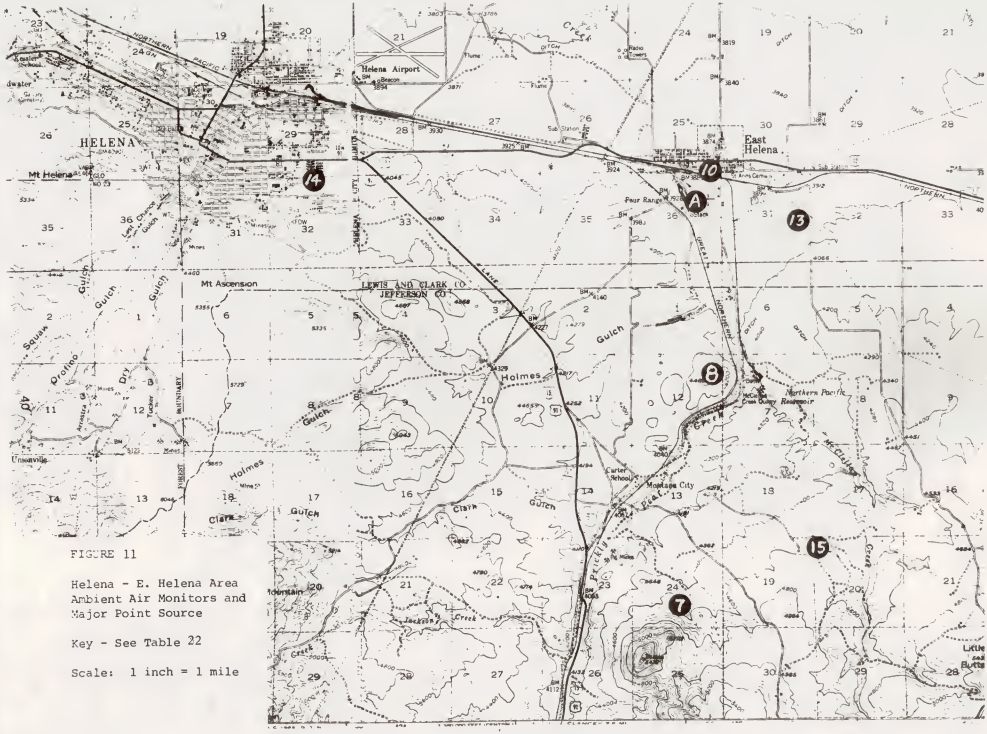


FIGURE 11

Helena - E. Helena Area
Ambient Air Monitors and
Major Point Source

Key - See Table 22

Scale: 1 inch = 1 mile

TABLE 22

Helena-East Helena Area
Ambient Air Monitors and Sources
(Key to Figure 11)

Ambient Air Monitors

Map No.	Site Name
7	Saddle Mountain
8	Microwave
10	212 Pacific St.
13	East Stack
15	Broudy Ranch

Major Point Source

Map No.	Source Name
A	ASARCO, Inc.

TABLE 23

SULFATION RATE DATA
Yearly Summary Helena Area - 1977
Values in Milligrams Sulfur Trioxide per
100 Square Centimeters Per Day

Site	Map* No.	Max.	Annual Aver.	No. Samples	Months Standards Exceeded	1976 Aver.	1975 Aver.	1974 Aver.
Saddle Mtn.	7	0.77	0.30	6	1	0.23	0.24	0.27
Microwave	8	0.65	0.39	10	2	0.30	0.30	0.32
212 Pacific St.	10	1.17	0.55	11	5	0.35	0.25	0.59
East Station	13	1.06	0.69	11	9	0.69	---	---
Broudy Ranch	15	0.48	0.34	3	0			

*See Figure 11

TABLE 24

TOTAL SUSPENDED PARTICULATE DATA YEARLY SUMMARY HELENA AREA

Jan. 1977 - Dec. 1977

Station*	Min.	Frequency Distribution (Concentration equal to or less than stated %) 10%	30%	50%	70%	90%	95%	98%	Max.	Arith. Mean	Arith. Std. Dev.	Geo. Mean	Geo. Std. Dev.	Total No. Obs.	Number of Samples Reported per Month Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Microwave	5	8	14	24	34	45	52	64	103	26.70	18.21	21.61	1.57	83	10	8	10	10	12	4	5	5	4	5	5
212 Pacific Street	12.	30	48	61	86	129	142	156	192	73.43	37.92	64.51	1.31	72	12	8	10	8	8	5	5	2	2	5	2

TABLE 25

SULFUR DIOXIDE DATA YEARLY SUMMARY HELENA AREA

Values in parts per million

Site	Map* No.	Maximum Reading 1-Hour	3-Hour	24-Hour	Arith. Aver.	Number of Readings Exceeding 1-Hour of 0.25	3-Hour or 0.50	24-Hour or 0.10	24-Hour or 0.14
Cogswell Bldg.	14	0.40	0.23	0.06	0.006	2	0	0	0
East Stack	13	0.66	0.42	0.15	0.013	31	0	6	1
Microwave	8	1.40	0.61	0.16	0.011	52	2	4	1
Saddle Mtn.	7	0.78	0.36	0.17	0.012	30	0	3	1
Broudy Ranch	15	0.88	0.60	0.26	0.037	17	3	2	2

*See Figure 11

TABLE 26

MONTHLY SUMMARY OF SURFACE WIND SPEED

East Helena-Microwave Site 1977
(Values in percent of occurrence)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Speed (m/sec)												
0.1-1.5	-	8.0	11.8	-	5.8	4.9	20.3	4.5	7.6	19.3	17.2	26.7
1.6-3.0	-	13.9	19.1	-	16.4	17.3	28.8	20.5	21.8	18.4	15.8	15.0
3.1-5.0	-	26.7	23.8	-	32.3	27.7	37.8	36.5	35.1	30.8	17.8	19.0
5.1-8.0	-	38.9	29.3	-	32.4	35.4	12.4	29.2	28.2	24.8	22.4	24.6
8.1-10.0	-	11.8	9.4	-	10.8	10.3	0.7	5.8	6.2	4.8	13.2	9.9
10.1-14.0	-	0.7	6.2	-	2.4	4.2	0.0	3.4	1.0	2.0	11.2	4.2
14.1-18.0	-	0.0	0.3	-	0.0	0.2	0.0	0.1	0.0	0.0	2.1	0.6
18.1-22.0	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Over 22.0	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calm	-	0.0	0.1	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aver. Speed (m/sec)	-	5.2	5.1	-	5.1	5.3	3.3	4.8	4.5	4.1	5.7	4.4

TABLE 27

MONTHLY SUMMARY OF SURFACE WIND DIRECTION

East Helena-Microwave Site 1977
(Values in percent of occurrence)

Direction	Jan	Feb*	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N	-	2.8	6.2	-	4.6	5.1	4.9	8.8	7.5	6.2	1.1	1.9
NNE	-	1.7	1.2	-	4.2	9.1	6.5	4.7	3.8	1.2	1.3	0.8
NE	-	0.0	0.9	-	1.5	3.7	7.0	2.0	2.4	1.4	0.1	0.8
ENE	-	0.3	3.1	-	2.2	3.5	10.3	4.2	4.3	3.0	1.5	1.0
E	-	1.4	1.9	-	1.9	1.7	2.8	1.6	2.2	2.0	0.6	1.0
ESE	-	1.4	1.2	-	3.2	4.7	4.5	1.9	2.2	2.7	2.2	1.4
SE	-	1.0	0.1	-	0.8	1.0	3.9	0.7	0.8	1.1	1.8	2.1
SSE	-	1.0	0.8	-	3.1	1.7	3.8	0.7	2.6	2.0	2.5	2.1
S	-	1.0	3.9	-	3.1	1.0	2.2	0.5	1.4	3.4	2.2	2.4
SSW	-	34.7	28.4	-	29.8	31.1	7.1	21.9	30.0	38.3	25.0	23.6
SW	-	2.8	4.6	-	5.2	3.7	4.2	6.4	8.2	5.9	6.5	9.4
WSW	-	16.3	16.8	-	9.4	4.7	23.7	6.5	10.7	7.7	21.0	15.0
W	-	16.3	12.1	-	6.0	3.7	6.1	3.8	3.2	5.3	8.2	8.3
WNW	-	13.5	7.8	-	9.4	13.1	10.2	12.4	5.7	9.1	11.7	17.1
NW	-	1.7	3.2	-	5.4	7.5	1.2	7.0	5.8	3.2	5.3	8.1
NNW	-	3.8	7.8	-	10.2	4.7	1.6	16.9	9.2	7.5	9.0	5.0

*Only partial month's data

Anaconda Area

A special study was continued in Region 142 in the Anaconda area jointly by the DHES and the Environmental Protection Agency. This study was oriented toward a copper smelter. The smelter is a large source of sulfur dioxide and particulates (See Table 28).

The smelter complex at Anaconda, Montana, consists of two plants, the pyrometallurgical smelter and the hydrometallurgical smelter. The two plants can produce 35 million and 6 million pounds of copper per month. However, legal agreements limit the combined output to 35 million pounds per month.

Major processes at this complex consist of two reverberatory furnaces (on stand-by) the electric furnace, seven converters, (4 on stand-by), two casting wheels, four refining furnaces, a baghouse, an electrostatic precipitator (on stand-by), a sulfuric acid plant, two lime kilns, the miscellaneous crusher boiler house, the Arbiter plant, concentrate blending area, tailings ponds, slag pile and concentrator (used for storage and blending).

The smelter currently has a variance from the 90% SO_2 control rule which applies to the smelter. Compliance with the SO_2 rule is related to achieving reliable operation of new smelting facilities followed by expansion of the sulfuric acid plant. Compliance with the particulate emission rule for the smelter is questionable as of now due to interpretations of the rules. Compliance with an interim 75% control rule for sulfur dioxide will not be achieved in late 1977 as planned, and the Company and state are now discussing another long-range control plan for SO_2.

The Anaconda-Butte area is the subject of an Air Quality Maintenance Plan for maintaining particulate and sulfur dioxide levels within the standards through 1985. The Anaconda area has also been designated as a non-attainment area for sulfur dioxide (primary).

Sampling was performed in the area for sulfur dioxide, wind speed and direction and particulate matter. Tables 29 through 32 summarize the data obtained in the study. Figure 12 also shows the relative locations of the source and the air monitors. Violations of the federal primary and state sulfur dioxide standards were recorded at several locations. The particulates sampling also resulted in a reading exceeding the federal secondary standard. The C-Hill, Hiway Jct, and Mill Creek R.R. sites recorded the highest sulfur dioxide concentrations. The C-Hill site recorded a maximum 1-hour value of 3.51 ppm and a 3-hour value of 2.87. The three sites had annual arithmetic averages of 0.023, 0.038, and 0.028 ppm, respectively. Tables 31 and 32 summarize the wind data collected at the Hiway Jct. site during 1977.

TABLE 28

Anaconda Smelter Complex
Estimated Emissions (Tons Per Year)

Source	Part	SO_2
Lime Kilns	Neg.	Neg.
Boiler Plant	7.1	Neg.
Converter Building Roofline	1,613.0	13,500
Main Stack*	8,400.0	306,200
Sulfuric Acid Plant*	70.6	1,200
Electric Furnace Matte Stack	65.5	231
Electric Furnace Slag Stack	32.3	5.
Casting Wheel	3.0	None

*Modifications made to the sulfuric acid plant late in 1977 and early 1978 will reduce emissions from both stacks.

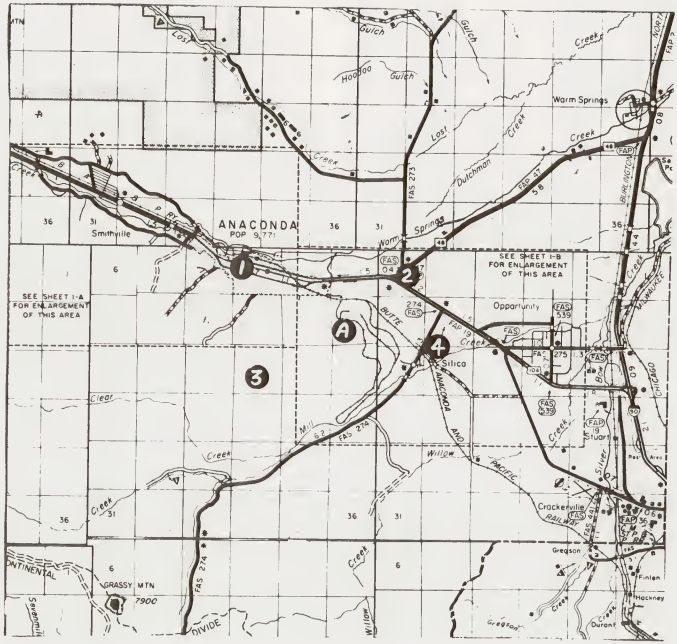


FIGURE 12

Anaconda Area

Ambient Air Monitors

Map No.	Site Name
1	Post Office
2	Hiway Junction
3	C-Hill
4	Mill Creek

Major Point Source

Map No.	Source Name
A	Anaconda Company

Scale: 1 inch = 2 miles

TABLE 29

Sulfur Dioxide Data
Yearly Summary Anaconda Area
Values in Parts Per Million

Site	Map* No.	Maximum Reading 1-hour	3-hour	24-hour	Arith. Aver.	Number of Readings Exceeding 1-hour of 0.25	3-hour of 0.50	24-hour of 0.10	24-hour of 0.14
C-Hill	18	3.51	2.87	0.64	0.023	186	31	31	17
Hiway Jct.	2	2.00	1.73	0.77	0.038	338	56	48	29
Mill Creek RR	5	1.68	1.58	0.67	0.028	186	23	20	15
Post Office	1	1.05	0.88	0.16	0.011	74	2	7	2

*See Figure 12

TABLE 30
Total Suspended Particulate Data Yearly Summary Butte-Anaconda
Jan. 1977 - Dec. 1977

Station*	Min.	Frequency Distribution (Concentration equal to or less than stated %) 10%	30%	50%	70%	90%	95%	98%	Max.	Arith. Mean	Arith. Std. Dev.	Geo. Mean	Geo. Std. Dev.	Total No. Obs.	Number of Samples Reported Per Month Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sil Bow Gen Butte	23	23	39	49	65	144	198	210	210	77.07	60.27	60.54	1.63	15	3	4	4	0	0	0	4	0	0	0	0	0
Greeley Sch Butte	18	43	51	72	100	174	192	226	233	92.71	55.32	78.70	1.40	41	1	4	4	0	0	0	8	5	5	5	4	5
Atkins Butte	1	10	22	35	45	60	125	129	130	41.68	32.18	30.54	2.33	38	4	4	4	0	0	0	4	5	5	4	4	4
Richer Res. Butte	2	10	17	19	25	32	43	46	49	21.81	9.92	19.38	1.35	42	4	4	4	0	0	0	5	5	5	5	5	5
Hiway Jct. Deer Lodge	3	18	33	42	58	84	103	121	161	49.80	29.58	41.31	1.57	59	5	4	4	5	6	4	6	5	5	5	5	5
Tierney Res.	9	16	25	30	41	61	69	78	89	35.67	18.20	31.52	1.30	42	3	4	4	0	0	0	6	5	5	5	5	5

*See Figure 13 for locations of many of the sites

TABLE 31

MONTHLY SUMMARY OF SURFACE WIND SPEED

Anaconda-Hiway Jct. Site 1977
(Values in percent of occurrence)

	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul	Aug.	Sep.	Oct.	Nov.	Dec.
Speed (m/sec)												
0.1 - 1.5	-	23.2	11.3	11.5	-	23.7	17.5	-	22.5	21.9	13.1	24.3
1.6 - 3.0	-	23.0	20.3	29.2	-	36.0	33.0	-	30.0	30.2	16.5	19.8
3.1 - 5.0	-	22.8	27.6	39.2	-	32.9	35.6	-	35.4	31.6	22.6	18.3
5.1 - 8.0	-	23.5	31.3	18.8	-	6.9	12.5	-	11.9	13.3	30.5	24.6
8.1 - 10.0	-	4.3	7.5	1.3	-	0.4	1.5	-	0.1	2.7	5.6	9.8
10.1 - 14.0	-	3.0	2.0	0.0	-	0.0	0.0	-	0.0	0.4	10.4	2.9
14.1 - 18.0	-	0.2	0.0	0.0	-	0.0	0.0	-	0.0	0.0	1.1	0.3
18.1 - 22.0	-	0.0	0.0	0.0	-	0.0	0.0	-	0.0	0.0	0.2	0.0
Over 22.0	-	0.0	0.0	0.0	-	0.0	0.0	-	0.0	0.0	0.0	0.0
Calm	-	0.0	0.0	0.0	-	0.0	0.0	-	0.0	0.0	0.0	0.0
Aver. Speed (m/sec)	-	4.0	5.6	3.7	-	2.8	3.3	-	3.1	3.3	5.4	4.3

TABLE 32

MONTHLY SUMMARY OF SURFACE WIND DIRECTION

Anaconda-Hiway Jct. Site 1977
(Values in percent of occurrence)

Direction	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul	Aug.	Sep.	Oct.	Nov.	Dec.
N	-	1.5	3.5	3.8	-	4.0	3.0	-	3.6	2.5	3.9	1.7
NNE	-	4.3	9.0	11.1	-	10.5	4.8	-	3.6	6.0	8.3	5.9
NE	-	2.3	1.7	5.2	-	9.6	9.5	-	5.6	3.0	0.6	3.2
ENE	-	2.5	2.6	3.0	-	7.2	7.4	-	5.0	2.1	0.9	3.5
E	-	1.5	0.9	3.0	-	2.7	2.5	-	1.0	0.5	0.2	0.8
ESE	-	2.0	1.7	4.1	-	4.9	2.1	-	1.8	0.9	0.2	1.7
SE	-	1.0	1.5	3.3	-	4.5	2.1	-	2.5	1.1	1.4	1.8
SSE	-	3.3	3.2	5.5	-	7.4	5.1	-	5.1	3.5	3.4	6.0
S	-	3.0	4.4	1.7	-	1.3	2.5	-	3.1	2.8	3.7	6.4
SSW	-	14.0	13.2	5.8	-	6.0	5.1	-	8.8	14.3	17.4	19.0
SW	-	7.7	8.5	4.9	-	4.7	5.4	-	8.1	9.9	14.3	9.2
WSW	-	18.0	15.1	19.3	-	19.9	23.6	-	26.8	23.3	11.2	12.7
W	-	7.5	6.0	5.5	-	4.9	5.7	-	7.4	8.3	3.6	5.3
WNW	-	26.2	24.5	18.3	-	6.0	14.1	-	14.6	18.4	25.9	20.0
NW	-	1.8	1.3	1.7	-	2.5	4.6	-	2.2	1.6	3.1	1.5
NNW	-	3.3	2.8	3.6	-	3.8	2.6	-	1.0	1.8	1.9	1.3

Butte Area

A study was continued in the Butte area for particulate emissions. The major source in the area is the large open pit mine. Emissions from transferring ore and heavy duty vehicle traffic emit large quantities of particulates, sulfur dioxide, hydrocarbons and oxides of nitrogen. Estimates of particulates alone average some 6000 tons per year (See Table 33). Particulate matter from this mine settles over the city and is re-entrained by vehicle traffic on city streets. Other sources in the area include a tepee burner, three hot mix plants, and a concentrator and crusher that process the ore from the mine. These sources, although insignificant compared to the emissions from the mine, do contribute to the overall pollution level.

Table 30 summarizes the particulate data collected in the area. The map in Figure 13 shows the relative locations of the mine and the air monitors. Violations of federal secondary and state particulate standards occurred frequently in the area. The Greeley School and Gilman Construction sites recorded the highest annual geometric means with values of 78.7 and 65.4 ug/m^3, respectively.

The Butte-Anaconda area is the subject of a plan being written to maintain the air quality in compliance with ambient air quality standards through 1985. The plan (Air Quality Maintenance Plan) is being written for particulates and sulfur dioxide. The Butte area has also been designated as a non-attainment area for particulates (secondary).

Tables 34 and 35 summarize the wind data collected at one site in the Butte area during 1977.

TABLE 33

Emission Sources at The Berkeley Open Pit Mine*

Source	Pollutant Emissions (Tons Per Year) Particulates	Sulfur Dioxide
Truck Exhaust	352	199
Other Equipment Exhaust	5	8
Blasting	36	---
Haul Roads	3010	---
Parking Lot	10	---
Shovel Operation	1425	---
Road Maintenance and Repair	184	---
Bulldozers and Front-end Loaders	460	---
Truck Dumping	569	---
Dragline	29	---
TOTAL	6080	207

*Reference (PEDCo, 1976)

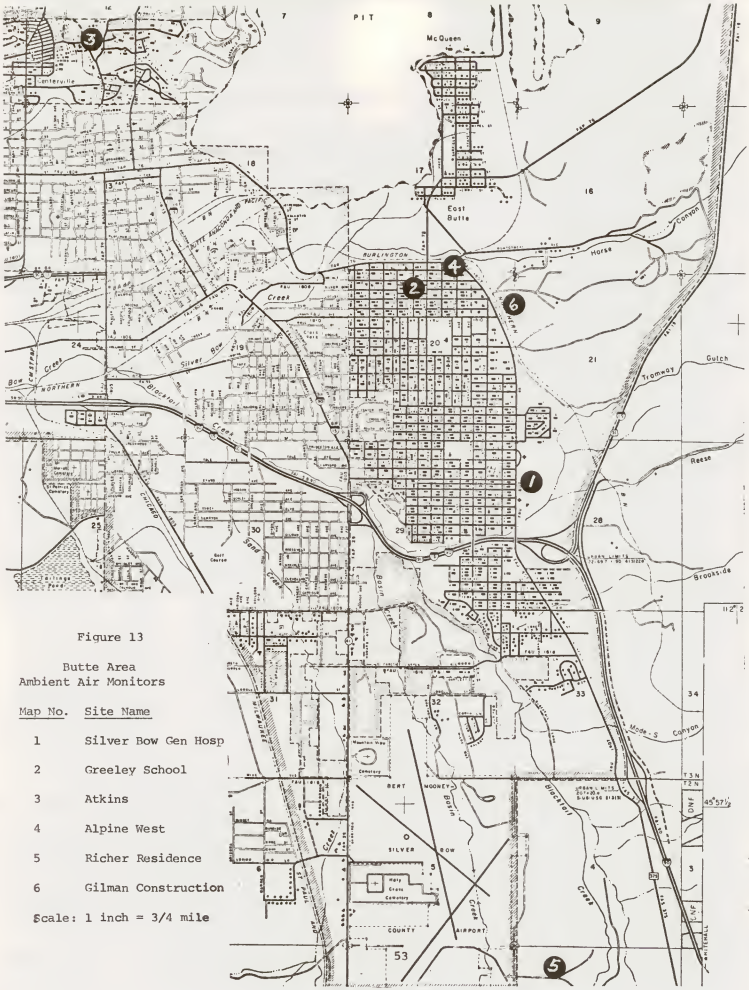


Figure 13

Butte Area
Ambient Air Monitors

Map No.	Site Name
1	Silver Bow Gen Hosp
2	Greeley School
3	Atkins
4	Alpine West
5	Richer Residence
6	Gilman Construction

Scale: 1 inch = 3/4 mile

TABLE 34

MONTHLY SUMMARY OF SURFACE WIND SPEED

Butte-Alpine West Site 1977
(Values in percent of occurrence)

	Jan	Feb	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Speed (m/sec)												
0.1-1.5	-	-	44.6	-	-	-	47.2	47.3	57.9	69.6	53.9	-
1.6-3.0	-	-	19.6	-	-	-	25.3	30.0	22.5	16.1	16.2	-
3.1-5.0	-	-	19.6	-	-	-	20.0	17.2	16.7	10.8	16.7	-
5.1-8.0	-	-	15.1	-	-	-	6.6	4.6	2.9	3.5	12.9	-
8.1-10.0	-	-	1.1	-	-	-	0.2	0.9	0.0	0.0	0.3	-
10.1-14.0	-	-	0.0	-	-	-	0.7	0.0	0.0	0.0	0.0	-
14.1-18.0	-	-	0.0	-	-	-	0.0	0.0	0.0	0.0	0.0	-
18.1-22.0	-	-	0.0	-	-	-	0.0	0.0	0.0	0.0	0.0	-
Over 22.0	-	-	0.0	-	-	-	0.0	0.0	0.0	0.0	0.0	-
Calm	-	-	0.0	-	-	-	0.0	0.0	0.0	0.0	0.0	-
Aver. Speed (m/sec)	-	-	2.7	-	-	-	2.3	2.2	1.9	1.6	2.4	-

*Only partial month's data

TABLE 35

MONTHLY SUMMARY OF SURFACE WIND DIRECTION

Butte-Alpine West Site 1977
(Values in percent of occurence)

Direction	Jan	Feb	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N	-	-	7.0	-	-	-	7.1	4.8	5.3	5.2	5.7	-
NNE	-	-	7.0	-	-	-	2.3	3.8	4.2	2.3	3.3	-
NE	-	-	5.3	-	-	-	3.2	5.1	1.4	1.7	6.2	-
ENE	-	-	4.6	-	-	-	3.9	6.9	2.8	3.2	5.7	-
E	-	-	2.8	-	-	-	3.6	4.5	2.8	3.4	3.5	-
ESE	-	-	5.6	-	-	-	8.0	7.7	9.7	7.0	7.6	-
SE	-	-	4.9	-	-	-	5.5	4.6	5.8	5.9	4.1	-
SSE	-	-	8.8	-	-	-	13.9	11.1	17.5	15.9	10.0	-
S	-	-	10.2	-	-	-	6.6	9.7	8.6	10.1	7.0	-
SSW	-	-	9.1	-	-	-	11.2	9.4	8.9	9.4	7.8	-
SW	-	-	3.2	-	-	-	3.4	4.6	3.6	4.8	4.0	-
WSW	-	-	6.3	-	-	-	6.4	8.0	4.9	7.5	9.2	-
W	-	-	2.1	-	-	-	4.3	3.2	3.1	4.4	4.3	-
WNW	-	-	12.3	-	-	-	4.8	5.6	5.8	6.5	11.3	-
NW	-	-	6.3	-	-	-	9.8	5.1	5.7	6.6	4.8	-
NNW	-	-	4.6	-	-	-	6.2	5.9	10.0	6.0	5.4	-

*Only partial month's data

Missoula Area

In Region 144, a monitoring program was continued in the Missoula area by the Missoula City-County Health Department. This program was orientated both for population and point-source type pollution sources. Late in 1977 a large scale air pollution study was started in Missoula and will eventually include Billings, Butte and Anaconda. Data from the study, called the Montana Air Pollution Study (MAPS), was not available at the end of 1977 for inclusion in this report.

The major industrial sources of air pollution in the Missoula Valley study area are, by and large, wood products plants. A pulp and paper mill, two plywood plants and a particle board plant are the major emitters. A number of sawmills also contribute their emissions to Missoula's air. Table 36 summarizes emission estimates for the major point sources in the area.

Table 37 summarizes the ambient air quality data collected in the area. Figure 15 shows the relative locations of the sources and air monitors. Samples were taken only for particulates. Particulate levels were in excess of both federal and primary and state ambient air quality standards at several locations in the area. Four sites recorded readings in excess of the federal primary standard with a maximum 24-hour reading of 335 ug/m^3. The Courthouse site had the highest annual geometric mean with a value of 82.8 ug/m^3, which is in excess of the federal primary standard of 75 ug/m^3.

Compliance schedules have been achieved for some of the point sources in the area. Final compliance for the particleboard plant was achieved in late 1977 and one lumber mill achieved final compliance by mid-1977. The one plywood plant has been cited for violations of the visible emission standards.

Missoula County is the subject of an Air Quality Maintenance Plan for maintaining particulate and carbon monoxide levels with the standards through 1985. Missoula also has been designated as a non-attainment area for particu-

lates (primary) and carbon monoxide.

TABLE 36

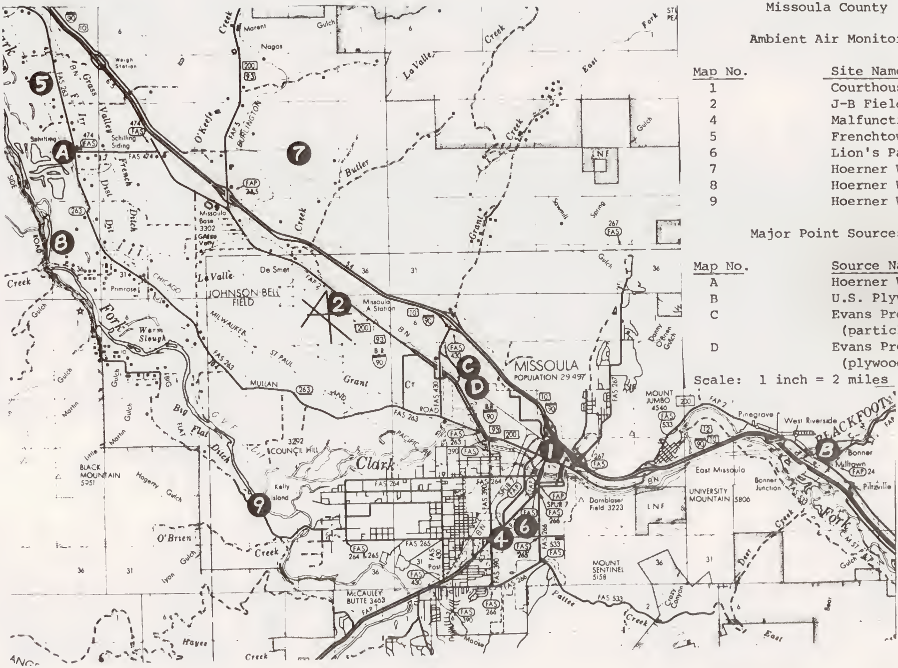
MISSOULA AREA MAJOR SOURCES
Estimated Emissions

Point Sources	Pollutant (Tons Per Year) SO_2	Part.	NO_x	HC	CO	TRS*
Louisiana-Pacific (particle-board)	Neg.	92	153	75	150	
Evans Products (plywood)	24	37	228	151	46	
Champion-Hoerner Waldorf	910	755	1008	115	1350	675
Champion-Intermountain	8	27	55	11	11	
Missoula White Pine Sash	7	7	61	12	12	
Champion-U. S. Plywood	224	288	1472	297	298	

*TRS - Total Reduced Sulfur

FIGURE 14

Missoula Area
Missoula County



Ambient Air Monitors

Map No.	Site Name
1	Courthouse (2)
2	J-B Field
4	Malfunction Jct.
5	Frenchtown
6	Lion's Park
7	Hoerner Waldorf
8	Hoerner Waldorf
9	Hoerner Waldorf

Major Point Sources

Map No.	Source Name
A	Hoerner Waldorf
B	U.S. Plywood
C	Evans Products (particleboard)
D	Evans Products (plywood)

Scale: 1 inch = 2 miles

TABLE 37

TOTAL SUSPENDED PARTICULATE DATA YEARLY SUMMARY MISSOULA COUNTY

Jan. 1977 - Dec. 1977

Station*	Min.	Frequency Distribution (Concentration equal to or less than stated %) 10%	30%	50%	70%	90%	95%	98%	Max.	Arith. Mean	Arith. Std. Dev.	Geo. Mean	Geo. Std. Dev.	Total No. Obs.	Number of Samples Reported Per Month Jan.	Feb.	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec.
CHR	12	43	68	85	106	161	203	229	295	94.6	50.70	82.77	1.32	347	28	27	31	30	31	29	31	31	29	31	20	29
JBF	7	21	36	49	60	92	107	125	180	52.9	28.75	45.75	1.37	347	30	25	30	29	31	26	30	30	29	31	29	27
FTN	5	20	30	41	55	78	99	129	255	47.4	29.51	40.50	1.37	225	31	27	31	30	31	28	31	16	0	0	0	0
HW1	6	11	20	28	38	50	55	62	79	29.7	14.67	25.81	1.36	223	0	0	0	0	13	30	30	29	30	31	29	31
HW2	3	11	20	32	41	52	60	65	113	31.5	16.83	26.49	1.52	232	0	0	0	0	26	30	30	29	30	30	27	30
HW3	4	9	13	17	28	41	44	59	76	21.9	14.18	17.95	1.51	130	0	0	0	0	0	0	0	12	28	31	30	29
CHL	4	38	56	77	109	144	161	209	279	87.4	46.89	74.64	1.48	100	0	0	0	0	0	0	0	0	17	31	26	26
LP	26	29	59	77	101	253	325	325	335	104.0	85.47	80.54	1.64	29	0	0	0	0	0	0	0	0	0	0	0	29

CHR - Courthouse Roof
JBF - J. B.Field
FTN - Frenchtown
HW1 - Hoerner Waldorf #1
HW2 - Hoerner Waldorf #2
HW3 - Hoerner Waldorf #3
CHL - Courthouse Lawn
LP - Lion's Park

Columbia Falls Area

A monitoring program was continued in the Columbia Falls area by the Air Quality Bureau. This program was orientated toward an aluminum reduction plant.

The aluminum plant and several wood products plants are the major industrial emission sources in the Flathead Valley. Estimates of annual particulate emissions of the aluminum plant are presented in Table 9.

Tables 38 and 39 summarize the ambient air quality data for the Columbia Falls area. The map in Figure 16 shows the relative locations of the aluminum plant and related air monitors. Results of sampling in the area show fluoride levels in excess of state ambient air quality standards at many locations in the Columbia Falls area. Fluoride sampling with Calcium Formate Papers resulted in the maximum one-month reading at the Anaconda South of 27.48 ug/cm^2/30 days. The Anaconda South site also recorded the highest annual average fluoride concentration with a value of 5.534 ug/cm^2/30 days. Tables 42 and 43 also show the average concentrations recorded during 1976, 1975 and 1974 for comparison.

The aluminum plant is currently on a compliance schedule which provides for compliance by June of 1979. This should reduce fluoride emissions by about 65% and particulate emissions by about 45%.

The Columbia Falls area is also presently the subject of a meteorological study which will be reported on in the near future.

Table 53 in the section on Western Montana gives particulate concentration data for two monitors in the Columbia Falls area. The monitors show concentrations exceeding the federal primary and state particulate standards in the City of Columbia Falls. The Anders Site recorded a maximum 24-hour reading of 467 ug/m^3 and an annual geometric mean of 92.9 ug/m^3. Based on this data and other information the Columbia Falls area has been designated as a non-attainment area for particulates (primary).

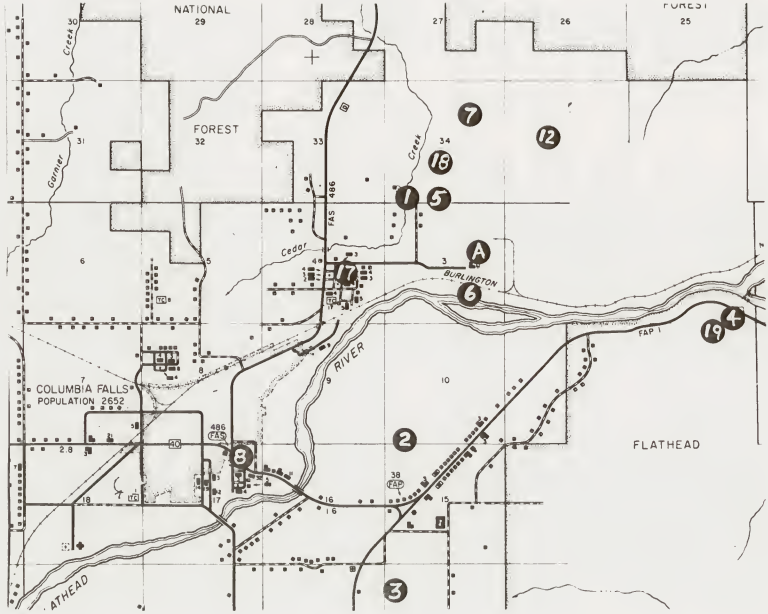


FIGURE 15
Columbia Falls Area

Ambient Air Monitors

Map No.	Site Name
1	Dehlbom Res.
2	Feirstein
3	R.E. Owen
4	Badrock
5	Dehlbom Field
6	Anaconda S
7	Teakettle #1
8	Anders Residence
17	Aluminum City
18	Trailer
19	Kenas Residence

Major Point Sources

Map No.	Source Name
A	Anaconda Aluminum

Scale: 1 inch = 0.80 miles

TABLE 38

GASEOUS FLUORIDE DATA (SODIUM FORMATE PLATES) YEARLY SUMMARY COLUMBIA FALLS AREA
VALUES IN MICROGRAMS FLUORIDE PER SQUARE CENTIMETER PER 30 DAYS

Site	Map+ No.	Max.	Annual Aver.	No. Samples	Months Standard Exceeded	1976 Aver.	1975 Aver.	1974 Aver.
Dehlbom Res.	1	2.00	0.91	12	11	0.91	0.61	1.41
Feirstein	2	0.84	0.51	10	8	0.43	0.50	0.98
R. E. Owen	3	0.48	0.29	12	7	0.25	0.16	0.37
Badrock Sta.	4	2.02	0.58	12	8	0.62	0.28	0.52
Dehlbom Field	5	2.85	0.95	12	11	0.76	0.73	1.29
Anaconda S	6	37.85	7.24	11	11	4.99	5.12	8.26
TK #1	7	4.44	1.86	7	7	1.22	2.89	7.00
TK #6	12	0.53	0.53	1	1	9.27	4.25	6.52
TK #8	NS	0.76	0.50	11	11	0.48	0.45	5.64
Aluminum City	17	3.25	1.06	11	11	1.07	0.96	1.79
Trailer	18	2.00	1.19	11	11	1.20	0.86	0.48
Kenas Res.	19	0.62	0.25	4	2	1.49	0.56	---
Glacier Park #1	NS	0.78	0.46	9	8	0.41	0.22	0.60
Glacier Park #2	NS	0.71	0.47	7	6	0.44	0.26	---
Glacier Park #3	NS	0.47	0.21	12	2	0.07	0.0	---
Glacier Park #4	NS	0.12	0.05	11	0	0.0	0.0	---
Glacier Park #5	NS	0.0	0.0	12	0	0.02	0.0	---
Glacier Park #6	NS	0.18	0.06	7	0	0.06	0.0	---
Glacier Park #7	NS	0.75	0.36	10	5	0.37	0.18	---
Glacier Park #8	NS	0.43	0.24	12	1	0.21	0.06	---
Glacier Park #9	NS	0.47	0.38	12	9	0.36	0.17	---
Glacier Park #10	NS	0.40	0.23	12	6	0.32	0.17	---

+See Figure 16
** NS - Monitor locations not shown on map

TABLE 39

GASEOUS FLUORIDE DATA (CALCIUM FORMATE PAPER) YEARLY SUMMARY COLUMBIA FALLS AREA
VALUES IN MICROGRAMS FLUORIDE PER SQUARE CENTIMETER PER 30 DAYS

Site	Map+ No.	Max.	Annual Aver.	No. Samples	Months Standard Exceeded	1976 Aver.	1975 Aver.	1974 Aver.
Dehlbom Res.	1	11.61	0.71	12	11	0.78	0.46	1.02
Feirstein	2	0.83	0.53	9	7	0.58	0.36	0.67
R. E. Owen	3	0.39	0.25	12	3	0.27	0.12	0.26
Badrock Sta.	4	1.72	0.47	12	7	0.52	0.20	0.39
Dehlbom's Field	5	1.74	0.72	12	10	0.72	0.56	0.85
Anaconda S	6	27.48	5.53	12	11	4.36	4.44	9.11
TK #1	7	3.13	2.16	12	12	1.95	2.68	7.33
TK #6	12	0.42	0.42	1	1	1.70	4.14	8.18
TK #8	NS	0.55	0.33	11	7	0.34	0.25	0.58
Aluminum City	17	3.23	1.04	12	12	0.89	0.47	1.07
Trailer	18	1.27	0.56	12	9	1.10	0.71	1.48
Kenas Res.	19	1.55	0.75	4	3	1.25	0.30	---
Glacier Park #1	NS	0.64	0.33	12	7	0.30	0.16	0.38
Glacier Park #2	NS	0.58	0.33	12	6	0.36	0.19	0.28
Glacier Park #3	NS	0.44	0.17	12	1	0.08	0.03	---
Glacier Park #4	NS	0.16	0.06	12	0	0.04	0.01	---
Glacier Park #5	NS	0.08	0.05	12	0	0.03	0.01	---
Glacier Park #6	NS	0.20	0.10	11	0	0.10	0.04	---
Glacier Park #7	NS	0.67	0.35	10	6	0.34	0.17	---
Glacier Park #8	NS	0.34	0.21	12	1	0.23	0.10	---
Glacier Park #9	NS	0.56	0.39	12	9	0.37	0.16	---
Glacier Park #10	NS	0.47	0.25	12	6	0.33	0.13	---

+See Figure 16
**NS - Monitor locations not shown on map

Eastern Montana

In eastern Montana monitoring was performed on the background air quality for large areas of possible coal development. This monitoring was mainly performed to establish a general background air quality level prior to coal development. Some monitoring was also performed around existing coal strip mines and power plants.

Background sampling was performed for particulates, nitrogen dioxide, and sulfur dioxide. Figure 17 shows the general locations of the samplers. Sulfur dioxide and nitrogen dioxide were sampled only at the Scobey, ~~and~~ Ft. Peck and Lame Deer Sites.

The results of the background sampling are presented in Tables 40 through 48. The results show very low concentrations of sulfur dioxide and nitrogen dioxide. Particulate concentrations vary from site to site with the maximum 24-hour concentration recorded of 535 ug/m^3 at the Ekalaka site. The highest geometric average concentration was 48.1 ug/m^3 which was also recorded at the Ekalaka site. Tables 43 through 48 summarize the wind data collected at three sites in eastern Montana during 1977. In the Scobey area three air quality stations were operated to establish a background prior to construction of a Canadian power plant. The sampling also included visibility, meteorology, vegetation, and soil (Gelhaus, 1978).

A special study was performed in the Colstrip area around two large power plants. The first plant started operation in the latter part of 1975, while second plant started during mid-1976. The new plants are sources of particulate, sulfur dioxide, oxides of nitrogen, hydrocarbons, carbon monoxide and many trace elements. Table 7 shows the emissions of particulates and sulfur dioxide.

Sampling was performed for many of the pollutants emitted by the source before and after construction and start up of the plants. No attempt was made to compare the data before and after startup in this report. The background data is the subject of another report (Gelhaus, 1976).

Tables 49 through 52 summarize the data for the Colstrip area. Results show very low concentrations of all pollutants except non-methane hydrocarbons. The highest particulate concentrations were recorded at the BN site with a maximum 24-hour value of 95 ug/m^3 and an annual geometric mean of 27.9 ug/m^3. Near zero concentrations of sulfur dioxide and oxides of nitrogen were measured in the studies. Non-methane hydrocarbons at the BN site (Rosebud County) showed a maximum 1-hour value of 0.50 ppm. Ozone values were not reported here as the validity of the data was determined as questionable following quality assurance checks. Tables 51 and 52 show the summary of wind data collected at the BN site near Colstrip.

Based upon data obtained from non-government monitors in the Colstrip area and other sources the Colstrip area has been designated as a non-attainment area for particulates (primary).

FIGURE 16
Eastern Montana
Ambient Air Monitors

Map No.	Site Name
1	Scobey (3)
2	Ekalaka
3	Ft. Peck
4	Lindsay (2)
5	Glendive
6	Miles City
7	Lame Deer
8	Broadus
9	BigHorn Co. (2)
10	Colstrip (2)

Scale: 1 inch = 22 miles

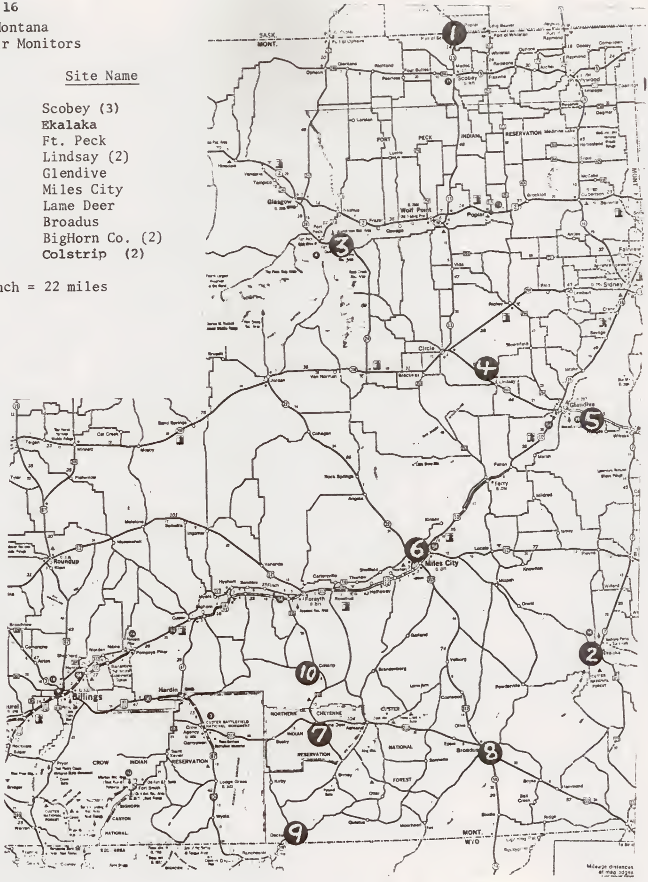


TABLE 40
TOTAL SUSPENDED PARTICULATE DATA YEARLY SUMMARY
Eastern Montana
Jan. 1977 - Dec. 1977

Site	Frequency Distribution (Concentration equal to or less than stated %)									Arith. Mean	Arith. Std. Dev.	Geo. Mean	Geo. Std. Dev.	Total No. Obs.	No. Samples Reported Per Month											
	Min.	10%	30%	50%	70%	90%	95%	98%	Max.						Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec
Morton Big Horn Co.	8	14	31	44	53	89	97	148	159	49.15	31.91	40.32	1.54	55	5	4	5	4	5	5	5	3	5	4	5	5
Warren Ranch Big Horn Co.	3	6	10	16	28	51	56	103	108	24.70	22.82	17.40	2.05	50	6	4	4	4	5	4	5	3	3	5	3	4
Littlefield Miles City	1	6	9	16	28	36	43	43	45	20.00	12.43	15.50	1.95	38	5	1	1	0	3	3	4	9	0	4	3	5
Scobey Daniels Co.	1	6	16	21	28	58	83	84	107	28.43	23.66	20.13	2.34	46	0	0	3	5	6	5	5	3	5	5	5	4
Richardson Daniels Co.	4	6	14	21	31	67	80	95	100	27.61	22.80	20.60	1.87	44	0	0	4	1	6	5	5	4	5	5	5	4
Engberg Daniels Co.	4	9	15	25	36	61	82	88	109	33.28	24.51	25.21	1.87	46	0	0	0	5	6	5	5	5	5	5	5	5
Glendive Dawson Co.	3	8	15	19	29	41	42	42	51	22.77	12.45	19.09	1.54	30	1	0	2	5	0	5	3	2	2	5	3	2
Lindsay (107349) Dawson Co.	4	4	22	29	38	46	46	156	156	38.15	37.56	27.87	2.03	13	0	0	1	4	4	0	4	0	0	0	0	0
Lindsay (107312) Dawson Co.	5	5	21	29	32	53	109	109	109	37.00	30.20	27.96	2.03	9	0	0	1	2	2	0	4	0	0	0	0	0
Fort Peck McCone Co.	2	4	8	16	30	46	72	75	88	24.91	22.16	16.42	2.62	35	0	4	2	2	1	1	5	4	4	5	4	3
Broadus Powder River Co.	1	4	9	17	25	35	45	51	275	23.02	36.14	14.40	2.61	57	5	4	4	5	6	5	5	4	5	5	4	5
Ekalaka Carter Co.	8	8	36	59	78	101	108	535	535	77.00	109.09	48.11	2.54	21	0	4	2	3	4	0	3	4	1	0	0	0
Lame Deer Rosebud Co.	6	7	10	13	17	21	25	243	243	25.74	52.87	14.81	1.84	19	0	0	0	1	2	0	2	4	5	4	0	1

TABLE 41

SULFUR DIOXIDE BUBBLER DATA
Yearly Summary Eastern Montana - 1977
Values in Parts Per Million

Site	Map+ No.	Geometric Mean	Arithmetic Mean	Maximum* 24-Hour Value	1976 A. Mean	1975 A. Mean	1974 A. Mean
Fort Peck McCone Co.		0.0000	0.0000	0.000	0.0	0.0000	---
Lame Deer Rosebud Co.		0.0000	0.0000	0.000	0.0001	0.000	---
Scobey Daniels Co.		0.0000	0.0000	0.000	0.0	---	---

*Minimum detectable level is 0.0. ppm for 24 hours
+ See Figure 17

TABLE 42
NITROGEN DIOXIDE BUBBLER DATA
Yearly Summary Eastern Montana - 1977
Values in Parts Per Million

Site	Map+ No.	Geometric Mean	Arithmetic Mean	Maximum* 24-Hour Value	1976 A. Mean	1975 A. Mean	1974 A. Mean
Fort Peck McCone Co.		0.0000	0.0003	0.011	0.0046	0.0050	---
Lame Deer Rosebud Co.		0.0000	0.0000	0.000	0.0029	0.0038	---
Scobey Daniels Co.		0.0000	0.0001	0.005	0.0040	---	---

*Minimum detectable level is 0.03 ppm for 24 hours
+See Figure 17

TABLE 43

MONTHLY SUMMARY OF SURFACE WIND SPEED

Scobey-Border Station Site 1977
(Values in percent of occurrence)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Speed (m/sec)												
0.1-1.5	-	-	23.6	25.8	-	-	-	-	65.9	47.4	27.1	20.4
1.6-3.0	-	-	17.3	19.0	-	-	-	-	25.0	27.2	18.8	17.9
3.1-5.0	-	-	24.3	24.2	-	-	-	-	5.8	12.4	20.2	26.0
5.1-8.0	-	-	23.1	20.8	-	-	-	-	1.1	7.5	16.6	18.4
8.1-10.0	-	-	10.6	8.2	-	-	-	-	0.2	1.1	7.9	9.4
10.1-14.0	-	-	0.1	0.1	-	-	-	-	0.4	1.2	4.0	5.1
14.1-18.0	-	-	0.0	0.0	-	-	-	-	0.0	0.0	0.6	0.8
18.1-22.0	-	-	0.0	0.0	-	-	-	-	0.0	0.0	0.0	0.0
Over 22.0	-	-	0.0	0.0	-	-	-	-	0.0	0.0	0.1	0.0
Calm	-	-	1.0	1.8	-	-	-	-	1.7	3.1	4.6	1.9
Aver. Speed (m/sec)	-	-	4.0	3.7	-	-	-	-	1.7	2.4	4.9	4.4

TABLE 44

MONTHLY SUMMARY OF SURFACE WIND DIRECTION

Scobey-Border Station Site 1977
(Values in percent of occurrence)

Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N	-	-	6.9	4.7	-	-	-	-	8.9	2.8	4.2	4.5
NNE	-	-	4.7	3.5	-	-	-	-	5.0	3.4	2.4	2.3
NE	-	-	3.0	3.3	-	-	-	-	6.3	1.3	2.4	2.3
ENE	-	-	0.8	2.8	-	-	-	-	5.2	1.1	2.1	3.0
E	-	-	3.4	4.6	-	-	-	-	12.1	6.1	3.8	10.0
ESE	-	-	5.1	1.3	-	-	-	-	7.4	5.3	2.1	7.6
SE	-	-	5.5	5.3	-	-	-	-	4.5	5.4	6.7	3.2
SSE	-	-	5.9	6.0	-	-	-	-	3.9	9.8	8.2	3.4
S	-	-	9.9	9.9	-	-	-	-	6.1	13.1	13.4	6.1
SSW	-	-	8.3	9.0	-	-	-	-	4.6	9.2	7.3	4.5
SW	-	-	4.5	6.1	-	-	-	-	1.3	4.6	3.6	2.8
WSW	-	-	4.5	4.3	-	-	-	-	1.9	5.3	5.0	3.4
W	-	-	9.9	7.6	-	-	-	-	5.2	8.8	7.9	6.1
WNW	-	-	6.1	7.9	-	-	-	-	9.1	9.7	11.3	13.0
NW	-	-	12.3	13.6	-	-	-	-	8.7	8.1	9.3	21.3
NNW	-	-	9.1	10.1	-	-	-	-	9.8	6.2	10.3	6.7

TABLE 45

MONTHLY SUMMARY OF SURFACE WIND SPEED

Ft. Peck-TV Hill Site 1977
(Values in percent of occurrence)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep*	Oct	Nov	Dec
Speed (m/sec)												
0.1-1.5	-	-	-	-	8.9	-	4.3	7.8	12.9	7.0	0.0	-
1.6-3.0	-	-	-	-	22.8	-	22.6	31.7	26.8	25.9	9.6	-
3.1-5.0	-	-	-	-	38.3	-	36.5	38.5	44.1	40.0	10.8	-
5.1-8.0	-	-	-	-	24.2	-	29.2	19.3	13.9	21.3	39.8	-
8.1-10.0	-	-	-	-	3.1	-	5.1	1.6	2.4	2.4	22.9	-
10.1-14.0	-	-	-	-	2.6	-	2.3	1.2	0.0	3.4	10.8	-
14.1-18.0	-	-	-	-	0.2	-	0.0	0.0	0.0	0.0	4.8	-
18.1-22.0	-	-	-	-	0.0	-	0.0	0.0	0.0	0.0	1.2	-
Over 22.0	-	-	-	-	0.0	-	0.0	0.0	0.0	0.0	0.0	-
Calm	-	-	-	-	0.0	-	0.0	0.0	0.0	0.0	0.0	-
Aver. Speed (m/sec)	-	-	-	-	4.4	-	4.6	3.9	3.6	4.3	7.4	-

*Only partial month's data

TABLE 46

MONTHLY SUMMARY OF SURFACE WIND DIRECTION

Ft. Peck-TV Hill Site 1977
(Values in percent of occurrence)

Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep*	Oct	Nov*	Dec
N	-	-	-	-	2.7	-	6.9	12.1	6.8	0.7	7.2	-
NNE	-	-	-	-	2.9	-	2.6	7.2	4.1	1.9	0.0	-
NE	-	-	-	-	2.2	-	2.8	5.3	4.1	2.6	1.2	-
ENE	-	-	-	-	6.7	-	4.7	6.6	10.2	3.4	1.2	-
E	-	-	-	-	4.5	-	2.4	1.4	7.5	0.5	0.0	-
ESE	-	-	-	-	13.4	-	7.0	4.9	8.5	4.6	2.4	-
SE	-	-	-	-	10.5	-	4.6	2.9	5.8	3.8	6.0	-
SSE	-	-	-	-	9.3	-	16.4	9.5	10.5	18.2	4.8	-
S	-	-	-	-	2.6	-	4.6	3.9	6.4	15.3	1.2	-
SSW	-	-	-	-	7.5	-	3.8	2.9	4.4	11.5	12.0	-
SW	-	-	-	-	6.0	-	1.6	2.3	1.0	3.1	7.2	-
WSW	-	-	-	-	16.6	-	3.0	1.6	4.7	4.8	6.0	-
W	-	-	-	-	3.8	-	4.3	1.9	1.0	6.5	4.8	-
WNW	-	-	-	-	4.6	-	16.6	10.7	7.5	14.4	38.6	-
NW	-	-	-	-	2.1	-	8.2	6.2	5.8	4.1	1.2	-
NNW	-	-	-	-	4.6	-	10.6	20.6	11.9	4.6	6.0	-

*Only partial month's data

TABLE 47

MONTHLY SUMMARY OF SURFACE WIND SPEED

Broadus-Randall Site 1977
(Values in percent of occurrence)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Speed (m/sec)												
0.1-1.5	21.1	6.5	10.5	-	10.1	18.8	11.4	13.8	18.1	-	-	-
1.6-3.0	17.6	14.4	20.4	-	21.9	25.6	21.2	25.0	32.2	-	-	-
3.1-5.0	22.6	26.6	25.1	-	25.9	25.6	29.0	33.8	26.6	-	-	-
5.1-8.0	25.3	36.9	24.5	-	27.0	27.5	30.6	21.8	17.5	-	-	-
8.1-10.0	8.4	11.0	9.0	-	7.0	1.9	6.2	3.5	4.5	-	-	-
10.1-14.0	4.5	4.3	9.8	-	6.7	0.6	1.6	1.5	1.1	-	-	-
14.1-18.0	0.6	0.1	0.7	-	1.2	0.0	0.0	0.5	0.0	-	-	-
18.1-22.0	0.0	0.0	0.0	-	0.1	0.0	0.0	0.0	0.0	-	-	-
Over 22.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	-	-	-
Calm	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	-	-	-
Aver. Speed (m/sec)	4.6	5.4	5.3	-	5.1	3.8	4.5	4.1	3.8	-	-	-

TABLE 48

MONTHLY SUMMARY OF SURFACE WIND DIRECTION

Broadus-Randall Site 1977
(Values in percent of occurrence)

Direction	Jan	Feb	Mar	Apr	May	Jun*	Jul	Aug	Sep*	Oct	Nov	Dec
N	11.9	4.6	13.8	-	7.3	10.6	10.7	15.2	5.6	-	-	-
NNE	5.2	2.1	6.9	-	4.1	13.8	5.2	16.9	7.9	-	-	-
NE	2.1	1.0	3.4	-	2.8	3.1	2.9	5.1	7.3	-	-	-
ENE	2.7	1.3	4.0	-	1.8	1.9	4.6	3.6	10.2	-	-	-
E	0.8	0.1	1.6	-	1.2	2.5	1.9	0.9	4.0	-	-	-
ESE	2.0	0.7	1.9	-	4.7	8.1	6.5	3.9	7.3	-	-	-
SE	0.6	0.3	0.8	-	3.9	7.5	3.5	1.7	4.0	-	-	-
SSE	2.0	0.1	1.3	-	6.0	9.4	6.2	4.4	11.9	-	-	-
S	2.1	1.3	3.1	-	10.5	8.8	6.2	2.9	6.2	-	-	-
SSW	17.0	16.1	16.9	-	20.3	11.3	17.7	14.5	14.1	-	-	-
SW	16.9	23.4	13.6	-	11.8	8.1	9.3	10.1	7.3	-	-	-
WSW	6.0	8.8	7.5	-	7.9	8.1	5.8	4.3	2.8	-	-	-
W	3.1	2.4	2.8	-	2.6	1.9	2.8	1.7	1.7	-	-	-
WNW	7.9	7.7	6.3	-	3.5	1.9	4.8	3.9	4.5	-	-	-
NW	8.0	9.2	3.0	-	3.8	0.6	3.2	4.8	0.6	-	-	-
NNW	11.8	20.7	13.0	-	7.7	2.5	8.7	7.7	4.5	-	-	-

*Only partial months data

TABLE 49
Total Suspended Particulate Data Yearly Summary McRae & BN Sites - Colstrip
Jan. 1977 - Dec. 1977

Station	Minimum	Frequency Distribution (Concentration equal to or less than stated %) 10%	30%	50%	70%	90%	95%	98%	Maximum	Arith. Mean	Arith. Std. Dev.	Geo. Mean	Geo. Std. Dev.	Total No. Obs.	Number of Samples Reported Per Month: Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
McRae Site Rosebud Co.	7	7	11	12	17	36	36	102	102	24.17	26.28	17.44	1.78	12	4	0	0	1	5	2	0	0	0	0	0	0
BN Site Rosebud Co.	1	11	20	26	38	54	71	71	95	32.42	21.19	24.96	2.19	26	5	0	0	3	4	3	3	4	3	0	1	0

TABLE 50
Continuous Monitor Data
Yearly Summary Rosebud County
Values in Parts Per Million

Site	Map* No.	Pollutant	Maximum Reading 1-Hour	3-Hour	8-Hour	24-Hour	Arith. Aver.	Standards Exceeded 1-Hour	3-Hour	8-Hour	24-Hour
BN Site	1	Total Hydrocarbons	2.70	2.30	---	1.70	0.925	---	---	---	---
		Methane HC	1.52	0.52	---	0.17	0.094	---	---	---	---
		Non-Methane	0.50	0.43	---	0.18	0.018	---	5	---	---
		Nitric Oxide	0.10	0.08	---	0.07	0.027	---	---	---	---
		Nitrogen Dioxide	0.13	0.11	---	0.10	0.029	---	---	---	---
		Oxides of Nitrogen	0.12	0.10	---	0.08	0.032	---	---	---	---
		Ozone**	---	---	---	---	---	---	---	---	---
		Sulfur Dioxide	0.10	0.07	---	0.05	0.002	0	0	---	0

* See Figure 16
**Ozone data was questionable and not reported here

TABLE 51

MONTHLY SUMMARY OF SURFACE WIND SPEED

Colstrip - BN Site 1977
(Values in percent of occurrence)

	Jan	Feb	Mar	Apr*	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Speed (m/sec)												
0.1-1.5	4.1	2.8	-	2.9	2.8	3.8	-	-	2.2	7.5	-	-
1.6-3.0	10.0	8.8	-	17.3	13.4	19.8	-	-	21.2	15.8	-	-
3.1-5.0	18.4	14.9	-	29.8	28.5	32.1	-	-	36.5	28.9	-	-
5.1-8.0	30.0	24.7	-	31.7	34.4	32.9	-	-	21.2	19.3	-	-
8.1-10.0	13.0	21.0	-	11.5	12.1	7.5	-	-	8.9	17.1	-	-
10.1-14.0	18.0	21.0	-	6.7	5.9	3.1	-	-	6.5	8.3	-	-
14.1-18.0	5.0	5.2	-	0.0	2.3	0.6	-	-	3.0	2.2	-	-
18.1-22.0	1.6	1.6	-	0.0	0.5	0.0	-	-	0.4	0.9	-	-
Over 22.0	0.0	0.0	-	0.0	0.0	0.2	-	-	0.2	0.0	-	-
Calm	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0	-	-
Aver. Speed (m/sec)	7.5	8.0	-	5.5	6.0	5.1	-	-	5.5	5.8	-	-

*Only partial month's data

TABLE 52

MONTHLY SUMMARY OF SURFACE WIND DIRECTION

Colstrip - BN Site 1977
(Values in percent of occurrence)

Direction	Jan	Feb	Mar	Apr*	May	Jun	Jul	Aug	Sep	Oct*	Nov	Dec
N	5.0	1.0	-	7.7	0.9	9.2	-	-	5.4	8.3	-	-
NNE	0.0	0.3	-	1.9	1.1	2.9	-	-	5.4	0.4	-	-
NE	0.0	0.0	-	1.0	1.3	1.2	-	-	4.1	1.3	-	-
ENE	0.7	0.6	-	0.0	2.8	4.0	-	-	7.4	3.9	-	-
E	1.4	0.6	-	1.0	4.8	7.7	-	-	6.9	13.6	-	-
ESE	6.1	1.5	-	15.4	18.3	26.5	-	-	9.1	9.2	-	-
SE	0.0	0.0	-	8.7	6.3	1.0	-	-	1.9	2.6	-	-
SSE	5.9	1.6	-	9.6	6.6	4.4	-	-	2.6	1.8	-	-
S	8.2	7.6	-	4.8	4.0	2.1	-	-	4.5	1.3	-	-
SSW	4.8	7.1	-	7.7	7.9	6.9	-	-	2.2	3.9	-	-
SW	0.5	0.1	-	2.9	3.1	1.2	-	-	1.1	1.3	-	-
WSW	9.5	14.6	-	3.8	8.3	3.7	-	-	6.3	4.4	-	-
W	25.2	33.2	-	2.9	7.0	3.8	-	-	12.6	14.0	-	-
WNW	18.4	22.3	-	11.5	15.1	12.5	-	-	17.6	17.5	-	-
NW	1.6	0.0	-	12.5	5.9	4.4	-	-	7.4	5.3	-	-
NNW	12.7	9.4	-	8.7	6.5	8.5	-	-	5.6	11.0	-	-

*Only partial month's data

Western Montana

In Regions 142 and 144 studies were performed around local sources of air pollution for several areas in western Montana. These studies were generally for assessing levels of particulate matter.

Figure 17 shows the general locations of the samplers. The results of the sampling are presented in Table 53. The results vary with each site. The highest concentrations were recorded around the Anders Site in Columbia Falls with a maximum 24-hour particulate concentration of 467 ug/m^3 and an annual geometric average of 92.94 ug/m^3. The highest geometric average of 104.95 ug/m^3 was recorded at the Brown site in Libby.

In the Troy area background sampling was performed to establish a baseline air quality prior to the development of an underground mine and associated facilities. The data will be included in an environmental impact study to be finished by mid-1978.

TABLE 53
TOTAL SUSPENDED PARTICULATE DATA YEARLY SUMMARY
Western Montana
Jan. 1977 - Dec. 1977

Site	Frequency Distribution (Concentration equal to or less than stated %)									Arith. Mean	Arith. Std. Dev.	Geo. Mean	Geo. Std. Dev.	Total No. Obs.	No. Samples Reported Per Month											
	Min.	10%	30%	50%	70%	90%	95%	98%	Max.						Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sept	Oct.	Nov	Dec
Anders Res. Columbia Falls	16	24	54	106	136	242	260	271	467	126.03	97.16	92.94	2.03	35	0	0	0	0	0	5	5	5	5	5	5	5
Dehlbom Res. Flathead Co.	6	10	18	23	30	46	65	71	126	28.20	21.31	22.84	1.52	45	0	0	2	4	6	5	4	4	5	5	5	5
McKinley Res. Granite Co.	2	14	29	51	79	144	147	183	217	64.18	49.57	44.83	2.53	50	3	3	5		3	6	5	3	4	5	5	4	4
Sherman Res. Kalispell	20	33	51	72	83	120	152	177	226	75.36	40.87	65.97	1.32	53	3	4	5	5	5	4	5	5	4	3	5	5
Sverdrup Libby	1	1	52	60	63	91	91	119	119	58.75	29.31	42.59	4.65	12	0	0	1	2	5	3	1	0	0	0	0	0
Brown Libby	29	42	94	118	147	187	191	196	196	117.53	50.87	104.95	1.32	19	0	0	0	0	0	0	0	0	4	5	5	5
Tierney Res. Silver Bow	9	16	25	30	41	61	69	78	89	35.67	18.20	31.52	1.30	42	3	4	4	0	0	0	6	5	5	5	5	5
Brown Troy	8	15	32	56	72	99	108	122	171	57.86	35.29	47.14	1.63	37	0	0	0	1	6	3	2	5	5	5	5	5
Sampson Troy	2	4	8	13	16	22	29	33	33	14.00	8.27	11.50	1.63	20	0	0	0	0	0	0	0	0	0	5	5	5	5
Kober Three Forks	17	19	36	79	137	229	266	309	309	110.00	88.15	77.01	2.28	23	0	0	0	0	0	0	0	0	5	5	3	5	5

Figure 17

Western Montana
Ambient Air Monitors

Map No.	Site Name
1	Sverdrup-Brown
2	Dehlbom
3	Anders
4	Downard
5	McKinley Res.
6	Tierney Res.

Scale: 1 in.=22 miles

REFERENCES

An Air Quality Assessment of Coltrip, Montana, Prior to Development to Coal-Fired Power Plants by James W. Gelhaus, Montana Department of Health and Environmental Sciences, January, 1976.

Preliminary Draft Anaconda-Butte AQMA Analysis by PEDCo-Environmental Specialists, Inc., July, 1976.

Background Air Quality Studies of the Poplar River Area of Northeastern Montana-1977, James W. Gelhaus, Project Coordinator, Montana Department of Health and Environmental Sciences, April, 1978.

APPENDIX A

Montana Ambient Air Quality Standard

Pollutant	Standard	Averaging Time
Suspended Particulates	75 ug/m^3	Annual
	200* ug/m^3	24-Hour
Sulfur Dioxide	0.02 ppm	Annual
	0.10+ ppm	24-Hour
	0.25[a] ppm	1-Hour
Settled Particulates	15 T/mi^2 (residential area)	3-Month
	30 T/mi^2 (industrial area)	3-Month
Suspended Sulfates	4 ug/m^3	Annual
	12[b] ug/m^3	--
Reactive Sulfur	0.25 mg SO_3/ 100 cm^2/day	Annual
	0.50 mg SO_3/ 100 cm^2/day	1-Month
Fluorides, Total in air (as HG)	1 ppb	24-Hour
Fluorides (Gaseous)	0.3 ug/cm^2/28 days	28-Days

[a]Not to be exceeded for more than one hour in any four consecutive days.

[b]Not to be exceeded more than one percent of the time.

*Not to be exceeded more than one percent of the days in a year.

+Not to be exceeded more than one percent of the days in a 3-month period.

Federal Ambient Air Quality Standards

Pollutant	Primary (ug/m^3)	Primary (ppm)	Secondary (ug/m^3)	Secondary (ppm)	Averaging Time
Particulates	75	---	60	---	Annual
	260*	---	150*	---	24-Hour
Sulfur Dioxide	80	0.03	---	---	Annual
	365*	0.14	---	---	24-Hour
	---	---	1,300*	0.5	3-Hour
Carbon Monoxide	10,000*	9.0	---	---	8-Hour
	40,000*	35.0	---	---	1-Hour
Photochemical Oxidants	160*	0.08	---	---	1-Hour
Hydrocarbons	160*	0.24	---	---	3-Hour (6-9 a.m.)
Nitrogen Oxides	100	0.05	---	---	Annual

*Not to be exceeded more than once/year

FEDERAL PREVENTION OF SIGNIFICANT DETERIORATION

ALLOWABLE INCREMENTS

	Area Classification				Not to Exceed
Particulates	I	II	II-Mod.*	III	
Annual Geo. Mean	5	19	19	37	75
Maximum 24-hour	10	37	37	75	150
Sulfur Dioxide					
Annual Arith. Mean	2	20	20	40	80
Maximum 24-hour	5	91	91	182	365
Maximum 3-hour	25	512	325	700	1300

*Applies to plants near Class I areas

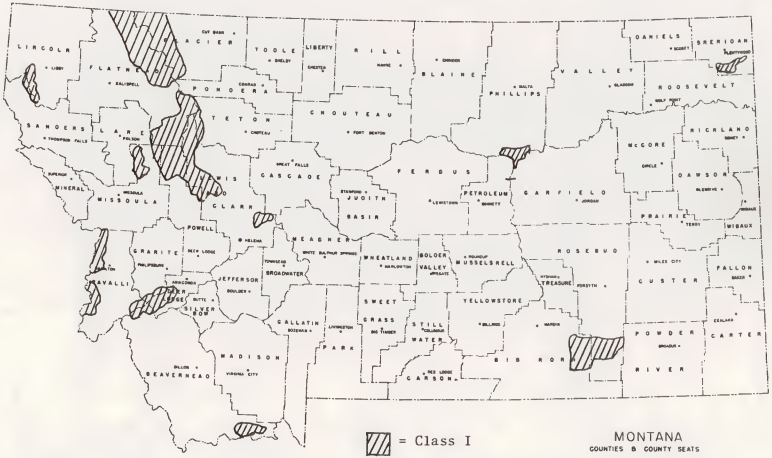
FEDERAL CLASS I AREAS

1977

Area	Location
Glacier National Park	NE Kalispell
Yellowstone National Park	S Bozeman
Bob Marshall Wilderness Area	SE Kalispell
Anaconda-Pintlar Wilderness Area	SW Anaconda
Selway-Bitterroot Wilderness Area	W Hamilton
Cabinet Mountains Wilderness Area	W Libby
Scapegoat Wilderness Area	NW Helena
Gates of the Mountains Wilderness Area	NE Helena
Mission Mountains Wilderness Area	SE Polson
Red Rock Lakes National Wildlife Refuge	S Virginia City
Medicine Lake National Wildlife Refuge	S Plentywood
U. L. Bend National Wildlife Refuge	SW Glasgow
Northern Cheyenne Reservation	SE Hardin

FEDERAL PREVENTION OF SIGNIFICANT DETERIORATION AREAS

1977



APPENDIX B

STAFF

Air Quality Bureau

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Robert Raisch	Air Analyst
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Dennis Braun	Chemist
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George Perusich	Field Technician
Hal Robbins	Field Technician
Marv Bauer	Field Technician
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